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Walla Walla River Ecological Flows—Recommended Stream Flows to Support Fisheries Habitat and Floodplain Function

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Cover photo: Walla Walla River near Lowden, WA

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1 INTRODUCTION

1.1 Overview

The purpose of this ecological flow study is to develop instream flow prescriptions to support the recovery and maintenance of all the CTUIR's fishery, but focuses on spring Chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*O. mykiss*), and bull trout (*Salvelinus confluentus*). The CTUIR fishery in the Walla Walla Basin includes spring Chinook salmon, steelhead trout, bull trout, rainbow trout, red band trout, mountain whitefish, Pacific lamprey, bridge lip and large lip suckers, and freshwater mussels. The prescriptions include instream flows that optimize, where feasible, the fishery and related habitat maintenance benefits. The instream flow prescriptions do not anticipate that all of the Walla Walla Basin flow is necessary to meet an optimum level of benefit, but only considers those flows that provide the most benefit before reaching a point of diminishing gain. In addition, flow prescriptions are made to support the riverine ecosystem that produces a more natural and healthy floodplain function consistent with the CTUIR River Vision (Jones et al. 2008). Continuity of habitat, healthy riparian vegetation and riverine biota, and connectivity of the river with the floodplain is provided by elements of a natural hydrologic regime (Jones et al. 2008), and these elements were considered in the flow prescriptions.

1.2 Setting

The Walla Walla Basin is located in Southeast Washington and Northeast Oregon and is a tributary to the Columbia River. The watershed drains 1,758 square miles. The Walla Walla River Basin experiences a semi-arid climate that is expressed by high winter precipitation in the form of snow and an extended summer drought, and translates into a stream flow pattern of high winter peaks and low summer flows. Beginning in the late 1800s, irrigation diversions from surface water and from groundwater pumping have occurred primarily in May through July.

The major drainages in the Walla Walla Basin are the Walla Walla River, the Touchet River, and Mill Creek (Figure 1). The study streams include the following major steelhead producing tributaries: Pine Creek, Dry Creek, Blue Creek, Cottonwood Creek, and Couse Creek. The study also includes a flow prescription for Yellowhawk Creek.

The Walla Walla Basin is situated in a geologic area known as the Columbia Plateau. The Plateau is comprised of volcanic basalt thousands of feet thick, overlain by loess, a wind derived soil originating from glacial outwash deposited by the Spokane Floods. Loess accumulated in deposits hundreds of feet thick called the Touchet Formation, and the resulting rolling hills are known as the Palouse (Kuttel 2001).

The headwaters of the Walla Walla River originate at an elevation of approximately 6,250 feet (Kuttel 2001). The geology of the upper watershed is volcanic basalt bedrock, overlain by varying depths of loess. The river is characterized by deep pools and boulder cascades with levee confinement from the Grove School Bridge (RM 46.4) through Milton Freewater, Oregon and extending downstream towards Walla Walla, Washington. Below Milton Freewater the river flows over an ancient alluvial deposit, comprised of a gravel aquifer which is hydraulically connected with the river. The transition from bedrock to alluvium near Milton Freewater creates a hydraulic gradient where the Walla Walla River loses surface water to the underlying aquifer. Loss of surface water is exacerbated downstream of Milton Freewater by groundwater pumping for agriculture, reduced floodplain recharge, and channelization and downcutting of the river. The lower Walla Walla River flows 25.7 miles through a valley with intensive agricultural use and joins the Columbia River at 343 feet in elevation.

The Touchet River originates in the Blue Mountains of Washington, at an elevation of 4,000–5,000 feet. The upper basin is comprised of deep valleys cut into Touchet Formation soils and high plateaus extending from the banks of the river to the valley walls. There is intensive agricultural use in the low-elevation, wide valley bottom and floodplain areas, RM 0–24, that extends to the river bank. The Touchet River joins the Walla Walla River downstream of Lowden at 423 feet in elevation.

Mill Creek originates in the Blue Mountains of Washington, at an elevation 4,000–5,000 feet, flows for about 5 miles in Oregon and returns to Washington. Mill Creek provides municipal water supply for the City of Walla Walla. The Army Corps of Engineers operates a flood control project on Mill Creek at Bennington Lake, 5 miles upstream of downtown Walla Walla. Downstream of Bennington Dam, the banks of Mill Creek have been leveed through the City of Walla Walla and downstream to approximately Gose Street. The channel is reinforced with channel spanning concrete weirs and the channel has been widened up to 300 feet in some areas. The stream channel has also been converted to a concrete channel through and under downtown Walla Walla.

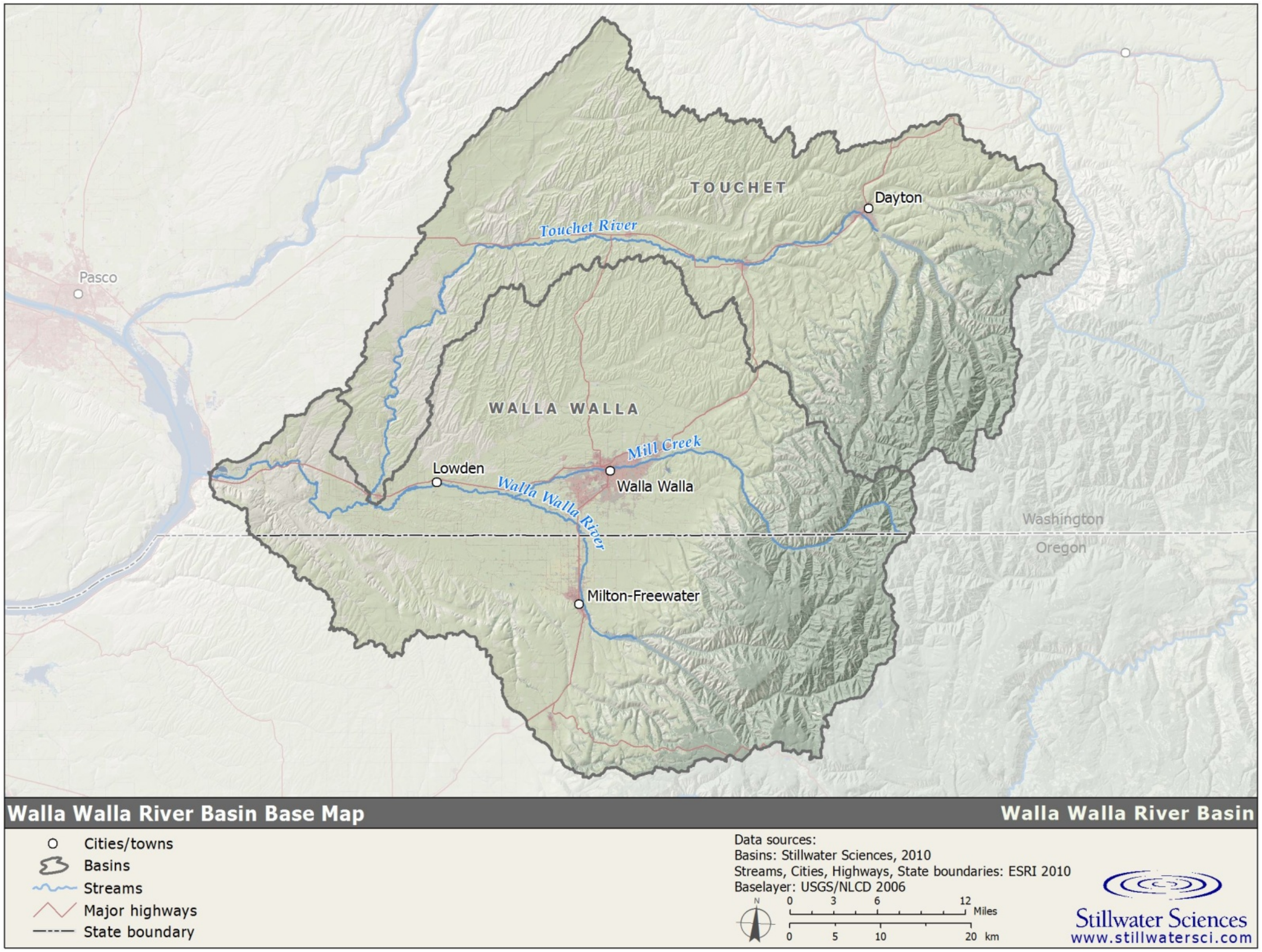

Figure 1. Overview map of the Walla Walla Basin.

1.2.1 Hydrology and alterations

Alterations of the hydrology of the Walla Walla River Basin began in the late 1800s to support agricultural production and community development. Over the last 100 years, significant factors altering the amount, timing, and quality of stream water have progressively become more significant as demand for water resources has continued to grow. These anthropogenic influences include municipal consumption, water diversion for cropland irrigation and livestock, and water storage (Walla Walla County and WWBWC 2004a). Other factors indirectly impacting the hydrology of the Walla Walla River Basin include straightening and leveeing of channels, confinement of the channel, both from infrastructure and vegetation encroachment, and the disconnection of the floodplain from the channel. These impacts have altered the river system so that the hydrology is significantly different from historical conditions, and the river no longer supports the diversity and abundance of fish species documented historically. For example, prior to significant stream flow alterations, the Walla Walla River Basin supported annual runs of spring Chinook salmon and summer steelhead. The last significant spring Chinook salmon run was in 1925, and by the 1950s the run was extirpated (Volkman and Sexton 2003). Summer steelhead still survive, but with numbers far below historical levels (NMFS 2009).

As stated in the guiding document of the Confederated Tribe of the Umatilla Indian Reservation (Jones et al. 2008), the 'River Vision' outlines the importance of a river's hydrology, geomorphology, habitat and network connectivity, riverine biotic community, and riparian vegetation that are essential in the sustained production of First Foods for tribal consumption. The ecologically based flow prescriptions provided in this report will support the vision outlined by the Tribe's River Vision by supporting the restoration and long-term maintenance of the CTUIR's fishery in the Walla Walla River Basin. Sustaining instream flows when there is demand for out-of-stream water use is challenging for water resource managers. Efforts to conserve or restore a functioning river corridor must often simultaneously address both land and water management. Thus, such efforts must overcome considerable scientific, technical, and socioeconomic challenges.

To address the need for suitable flow conditions in the Walla Walla River Basin, while balancing the demand for out-of-stream water use, this study presents a two-tiered approach to addressing desirable flow conditions in the Walla Walla River Basin. First, by using knowledge of the requirements for fish species survival, instream flow targets were quantified for those life stages of priority species that are the most limiting to population viability. Second, by using knowledge of the influence of hydrology on ecological and geomorphic processes, important components of the hydrologic regime by which to establish variable flow prescriptions were determined. Prescriptions for suitable flow regime characteristics to support indigenous fish are based on a minimum flow prescription, as well as higher magnitude flow values. These flow prescriptions provide a suite of conditions necessary for the maintenance of migration corridors and suitable habitat for fish, support processes that maintain desirable streambed sediment size and mobility, and maintain floodplain functions such as patch dynamics of riparian vegetation, recruitment of large woody debris, and maintenance of floodplain connectivity. An advantage of this approach is that ecological benefits of the environmental flow are clearly articulated, available knowledge is included in the development of flow prescriptions, and the method accounts for the natural dynamics in flow-related ecosystem processes by using the natural flow regime as a template for flow variability prescriptions.

1.2.2 Priority species and species of concern

Priority species and species of concern in the Walla Walla Basin were identified by the CTUIR as First Foods. First Foods are identified in tribal creation beliefs as those animals and plants which answered the Creator's question, "Who will take care of the Indian people?" by stepping forward and promising to nourish them (Jones et al. 2008). Water, salmon, steelhead, trout, lamprey, whitefish, suckers, and freshwater mussels were among the first to step forward (Jones et al. 2008). CTUIR stresses managing the landscape and riverine environment to preserve their ability to harvest and prepare the First Foods as a continuation of their culture.

Three priority fish species were identified as proxies for the other aquatic First Foods in the Walla Walla Basin: spring-run Chinook salmon, bull trout, and steelhead trout. The assumption is that stream flow (as a 'master variable' in the riverine ecosystem and a primary driver in stream habitat variability and riparian dynamics [Richter et al. 2003]) that supports these three salmonid species also supports the other aquatic First Foods. These salmonid species have the most restrictive flow requirements of the First Foods species. Their water temperature requirements are more conservative (i.e., colder) than the other species, their habitat requirements are more complex (e.g., instream habitat structure, hydraulic variability, spawning conditions), and their life history needs are more extensive and flow dependent (e.g., migration flows, holding habitat, rearing areas, seasonal changes in flow). Thus, when the more conservative flow needs of these species are addressed, the less restrictive needs of species such as brook lamprey (the CTUIR intends to reintroduce Pacific lamprey to the Walla Walla River Basin in the near future [G. James, Fisheries Program Manager, CTUIR, pers. comm., 8 May 2013]), whitefish, suckers, and freshwater mussels can reasonably be expected to be met as well.

1.2.2.1 Spring Chinook

Spring Chinook salmon were historically abundant in the Walla Walla River Basin, but annual returns were reduced dramatically following the construction of Nine Mile Dam on the Walla Walla River in 1905 (Nielsen 1950, Van Cleve and Ting 1960). Federal listing of the Middle Columbia River spring Chinook Evolutionarily Significant Unit (ESU) as threatened or endangered under the Endangered Species Act (ESA) was determined to not be warranted on March 9, 1998 (63 FR 114827). Historically, spring Chinook populations from the Walla Walla River may have belonged in this ESU, but these populations are now considered extinct (63 FR 11482).

Spring Chinook were reintroduced to the Walla Walla Basin by the CTUIR in 2000. Although the native run has generally been considered to be functionally extinct, some spring Chinook were regularly observed in the basin prior to the 2000 reintroductions (Mahoney et al. 2009). Spring Chinook returning to the basin were observed at the Nursery Bridge fish ladder at RM 44.7 and the Touchet River trap at RM 54. These fish were presumed to be strays from the Umatilla River (Walla Walla County and WWBWC 2004a). Since 2000, the number of adult returns has steadily increased.

The historical distribution of spring Chinook in the Walla Walla River Basin is unknown due to extirpation of the species. Currently, spring Chinook are found in the Walla Walla River and have a core spawning area in the South Fork of the Walla Walla River. Currently, the Tribe outplants approximately 100 adult spring Chinook per year in upper Mill Creek. Spring Chinook that migrate up Mill Creek are enumerated at Mill Creek Dam at RM 11.5 (Mahoney et al. 2011). Spawning in upper Mill Creek occurs between the Stateline and Watershed Dam (the water diversion for the City of Walla Walla) (Mahoney et al. 2011). Information on spring Chinook distribution and abundance in the Touchet Basin is limited (Mahoney et al. 2011). Adult spring Chinook have been observed at Dayton Dam on the Touchet River near Dayton since 1999. In 2010, spawning was observed in lower North Fork Touchet River, lower Wolf Fork Touchet River, and in the mainstem Touchet River downstream of the South Fork (Mahoney et al. 2011). The CTUIR will outplant 100 spring Chinook into the Touchet River above Dayton once source fish are available from the Umatilla program (G. James, Fisheries Program Manager, CTUIR, pers. comm., 8 May 2013).

1.2.2.2 Steelhead trout

The Middle Columbia River Steelhead DPS was federally listed as threatened on March 25, 1999 (64 FR 14517). Their threatened status was reaffirmed in NMFS' final listing determination issued on January 5, 2006 (71 FR 834). Critical habitat for Middle Columbia River steelhead was designated by NMFS on September 2, 2005 (50 CFR 226). Steelhead found above the Dalles Dam in the mid-Columbia River Basin are stream-maturing or summer steelhead (Busby et al. 1996) that typically re-enter the freshwater system in a sexually immature state in the summer, reside in freshwater streams throughout the fall and winter, and spawn the following spring. Steelhead abundance, distribution, and population trends throughout the Washington portion of the Walla Walla River Basin are monitored by WDFW and the Tribes. Based on scale analysis, steelhead found in the Touchet River have greater life history diversity than those in the Walla Walla River Basin. Mahoney et al. (2009) found that a majority of Walla Walla steelhead spend two years in freshwater and two in saltwater with a maximum freshwater experience of three years. They also found that nearly half of the Touchet River steelhead spend two years in freshwater and one year in saltwater. The other half either had a similar life history to those in the Walla Walla River Basin or spent four years in freshwater and two years in saltwater before returning to spawn.

1.2.2.3 Bull trout

The Columbia River Bull Trout DPS was federally listed as threatened on June 10, 1998 (63 FR 31647). Revised critical habitat for bull trout throughout the coterminous United States was recently proposed by the U.S. Fish and Wildlife Service (USFWS) on January 14, 2010 (Proposed rule, 75 FR 2270). Although DPSs were not officially redesignated concurrent with the proposed critical habitat designation, they are under review and bull trout populations have been grouped into six recovery units and 32 separate critical habitat units. Based on adult tissue samples from Walla Walla River, Mill Creek and Touchet River and genetic analyses, bull trout populations show strong genetic separation between basins (Mendel et al. 2007). Bull trout exhibit two main life histories; resident and migratory. Resident bull trout remain in their natal headwater stream for their entire life cycle, whereas migratory bull trout rear for one to four years in small streams and then migrate to larger rivers and estuarine or marine environments before returning to spawn in the same tributary (Weeber et al. 2007). Populations with different life histories may occupy the same stream.

2 APPROACH

Developing instream flow prescriptions requires an understanding of the geologic setting, hydrology, location and timing of the priority species in the Walla Walla Basin, limiting factors to each life stage of the priority species, and effects of land use and water diversions on all of the above. An extensive literature review provided context for the natural setting of the Walla Walla Basin and the changes to the riverine environment brought about by flood control, irrigation and agriculture. A suite of study elements were used to determine the impacts of these changes on fisheries. The Walla Walla River, Mill Creek, and Touchet River were divided into reaches based on major hydrologic breaks and fish use. Life history tables specific to priority species in the Walla Walla Basin were developed. Temperature data were analyzed on a reach scale in order to assess the impact of temperature on all life stages of priority species. A limiting factor analysis was conducted to determine the effects of changes to habitat, flow, water quality, water temperature, and channel condition on the priority species. Using the results of the limiting factor analysis, critical life stages for priority species were established to focus the ecological flow assessment. Hydrologic analysis established a dataset that represented the seasonal hydrology of the Walla Walla Basin to inform the development of ecological flow prescriptions.

2.1 Reach Delineation

The Walla Walla Basin was divided into discrete reaches based on hydrologic and fisheries criteria. Hydrologic criteria included tributary confluences with mainstem channels, dams, major diversions, and in the case of Mill Creek, distinct changes in channel geometry. Fisheries criteria, such as habitat quality and quantity, suitability of flow, and temperatures for critical life stages and substrate condition, were based on potential fish use delineated by the EDT analysis of the Walla Walla Basin (Walla Walla County and WWBWC 2004a).

The Walla Walla River mainstem has six reaches and six main tributaries (Pine Creek, Dry Creek, Yellowhawk Creek, Couse Creek, and North and South forks of the Walla Walla) (Figure 2). Reach 1 extends from the mouth of the river to the confluence with the Touchet River. Reach 2 extends from the Touchet River confluence to the confluence with Dry Creek near Lowden. Reaches 1 and 2 both serve primarily as migration corridors for salmonids. Pine Creek enters the mainstem Walla Walla River at the downstream end of Reach 2. Pine Creek supports steelhead spawning and rearing. Reach 3 extends from the Dry Creek confluence to the Mill Creek confluence and currently serves as rearing habitat for steelhead, bull trout, and Chinook (Walla Walla County and WWBWC 2004a, Mendel et al. 2007). Dry Creek enters the mainstem between Walla Walla Reach 3 and Reach 4. Dry Creek supports steelhead spawning and rearing. Reach 4 extends from the Mill Creek confluence to the Yellowhawk Creek confluence. Reach 4 provides rearing habitat for steelhead, bull trout, and Chinook, and serves as a corridor between Mill and Yellowhawk creeks during periods of migration. Yellowhawk Creek enters the mainstem between Reach 4 and Reach 5. Yellowhawk Creek serves as a migration corridor for salmonids and provides limited spawning and rearing habitat for steelhead. Cottonwood Creek is a tributary to Yellowhawk Creek and supports steelhead spawning and rearing. Reach 5 (Tumalum Reach) extends from the Yellowhawk Creek confluence to the confluence with Couse Creek. This reach contains the Little Walla Walla and Eastside diversions, which combined formerly diverted all available flow from the mainstem Walla Walla River, leaving the Tumalum Reach below the Little Walla Walla Diversion dewatered. Reach 5 is an important migration corridor for salmonids and provides rearing habitat for all priority species. Couse Creek enters the mainstem between Reach 5 and Reach 6 and supports steelhead. Reach 6 extends from the Couse Creek confluence to the confluence of the North and South forks of the Walla Walla River. Reach 6 is a migration corridor for all priority species and provides spawning habitat for spring Chinook and steelhead. Juvenile bull trout, steelhead and spring Chinook rear in Reach 6. The South Fork Walla Walla and North Fork Walla Walla reaches extend to the upper limits of steelhead distribution in their respective tributaries. South Fork Walla Walla supports migration, spawning and rearing of spring Chinook, bull trout and steelhead. North Fork Walla Walla supports steelhead spawning and rearing.

Mill Creek was divided into five reaches (Figure 2). Mill Creek is used as a migration corridor by all priority species. Reach 1 extends from the mouth of Mill Creek to the beginning of the concrete weir channel at Gose Street. Reach 1 provides rearing habitat for Chinook, steelhead and bull trout in addition to migration. The channel of Reach 1 is undersized with respect to Mill Creek Basin area as a result of flood control practices and reduced irrigation season flows, but remains relatively natural as compared to Reach 2 upstream. Reach 2 extends from Gose Street to Bennington Dam, incorporating the concrete weir and concrete channel sections of Mill Creek. Low flow and high temperatures in Reach 2 combine to create poor habitat for steelhead juveniles. It is expected that rearing conditions for steelhead as well as spring Chinook would improve in Reach 2 with planned channel and stream flow restoration. Reach 3 extends from Bennington Dam to the confluence with Blue Creek and provides spawning and some rearing habitat for steelhead. Blue Creek provides spawning and rearing habitat for steelhead. Reach 4 extends from Blue Creek to the City of Walla Walla Diversion and is used as spawning and rearing habitat by bull trout, steelhead and spring Chinook. Reach 5 includes mainstem Mill Creek and tributaries and extends from the diversion to the upper limit of steelhead distribution. Reach 5 is used by steelhead, Chinook and bull trout for spawning and year-round rearing for all priority species. Mill Creek has highly altered hydrology compared with historical conditions due to the Army Corps of Engineers flood control project at Bennington Lake and irrigation demands diverting water into Yellowhawk and Garrison creeks.

The Touchet River was divided into five reaches, including two mainstem reaches (Reaches 1 and 2), and three tributary reaches on Coppei Creek, North Fork Touchet River, and South Fork Touchet River (Figure 3). The Touchet River is used as a migration corridor for all priority species and may serve as rearing habitat for spring Chinook and steelhead. Reach 1 extends from the mouth of the Touchet River to Coppei Creek and primarily serves as a migration corridor for salmonids. The Coppei Creek reach includes the mainstem and North Fork Coppei Creek and supports steelhead. Reach 2 extends from Coppei Creek to the confluence of the North and South forks Touchet River and incorporates a run-of-the-river dam at Dayton, WA. Spring Chinook and steelhead rear in Reach 2. The North Fork Touchet River reach includes the Wolf and Robinson forks, and supports steelhead, bull trout, and spring Chinook spawning and rearing. The South Fork Touchet River reach includes the Burnt, Griffin and Green forks, and supports steelhead spawning and rearing.

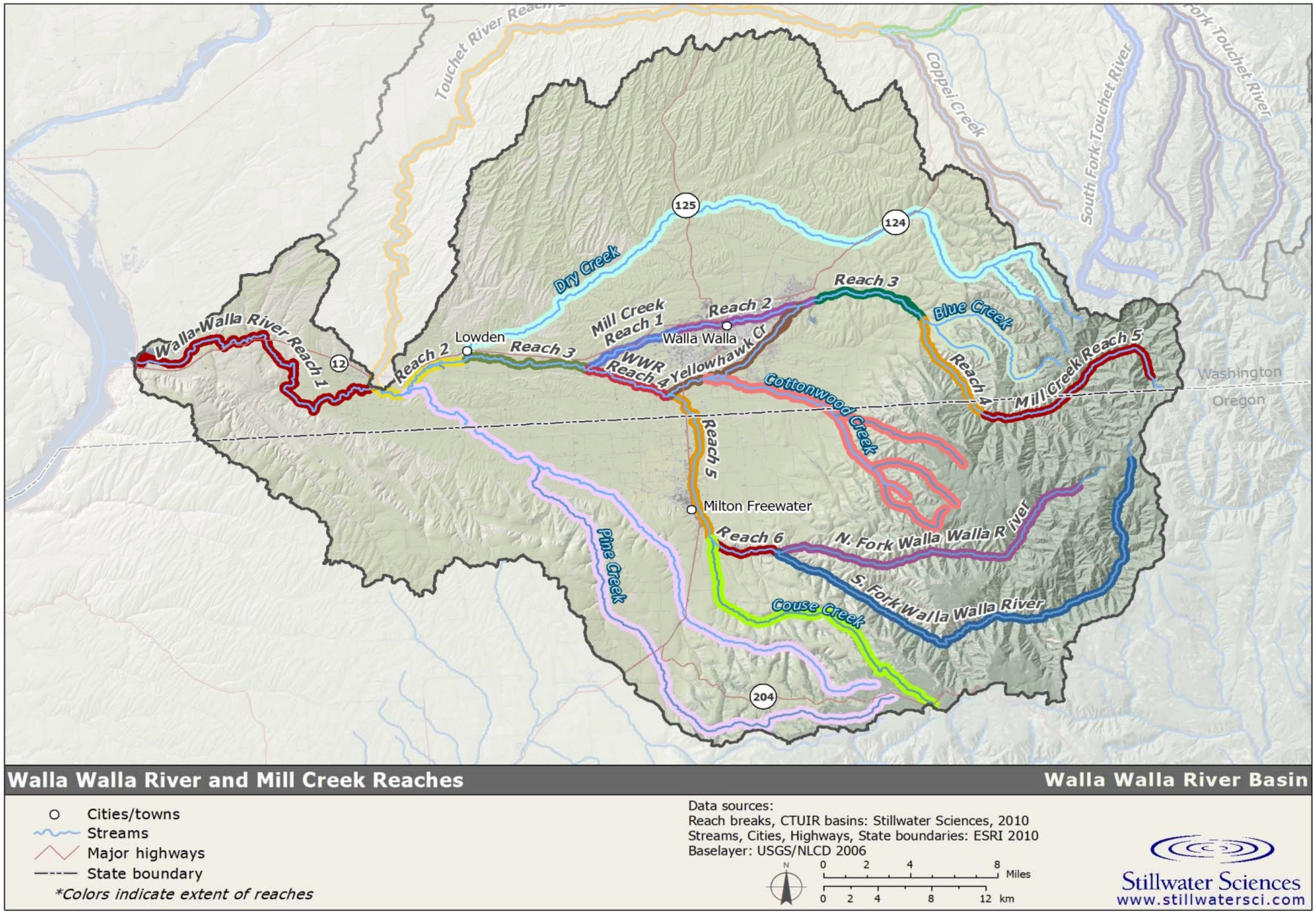

Figure 2. Walla Walla River and Mill Creek reaches.

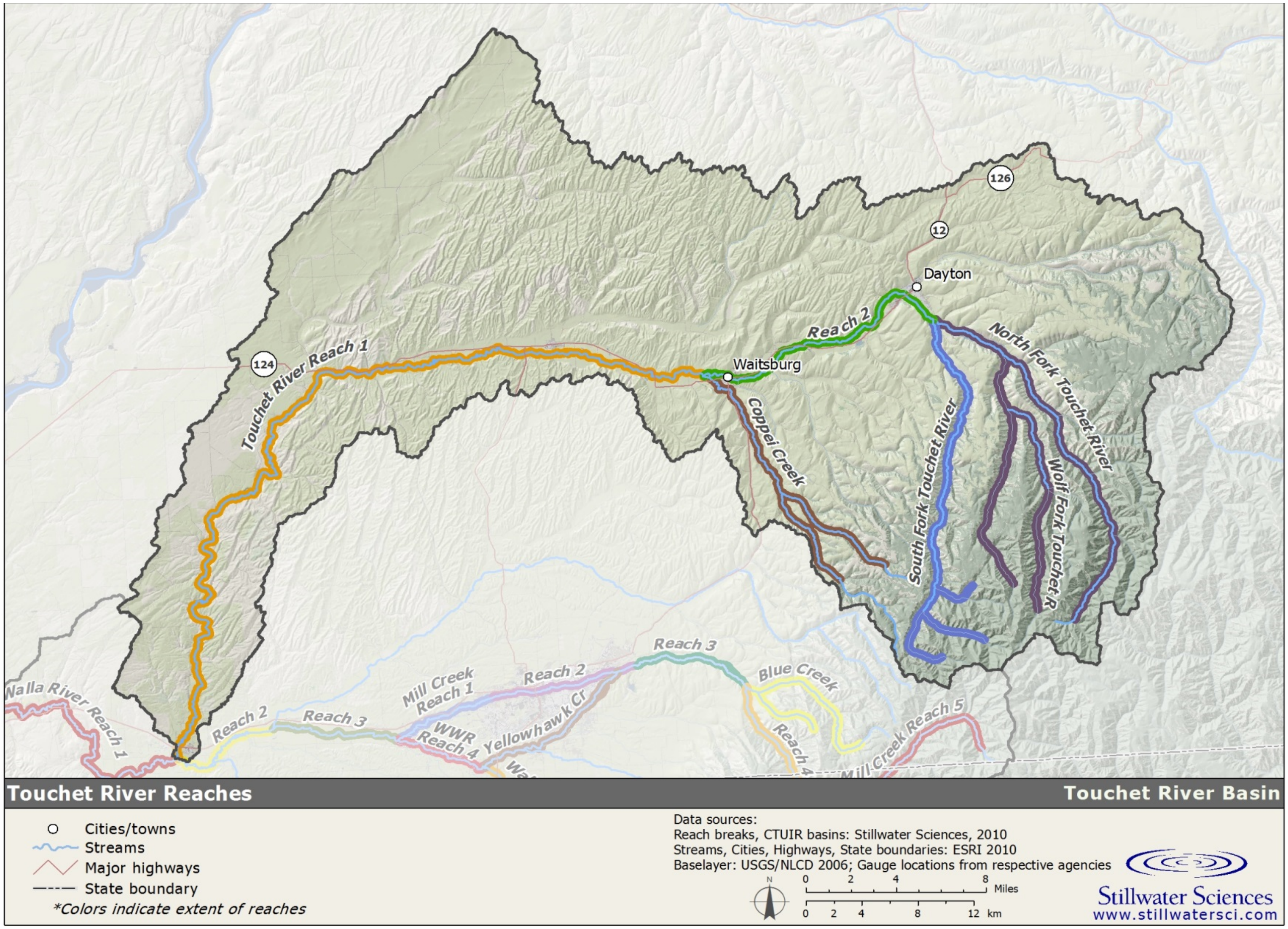

Figure 3. Touchet River reaches.

2.2 Species Periodicity

Life history tables of spring Chinook, bull trout, and steelhead were compiled from literature specific to the Walla Walla Basin, and refined with input from fish biologists Brian Mahoney (CTUIR) and Glen Mendel (WDFW) (see Table 1, Table 2, and Table 3). For priority species, each life stage was assigned peak and non-peak time periods in order to refine the months when the life stage was most likely found in the Walla Walla Basin. The species periodicity tables were then refined with information from basin-specific literature to determine the distribution and timing of habitat use by priority species and life stages on a reach scale. Refining the periodicity of each species' habitat use in the Walla Walla Basin allowed for focused analysis of limiting factors in each reach by life stage (see Section 2.4).

2.3 Temperature

Temperature data were obtained from Washington Department of Ecology (WDOE), Washington Department of Fish and Wildlife (WDFW), CTUIR, and the Walla Walla Basin Watershed Council (WWBWC). Raw temperature data were converted to hourly minimum, maximum, and average values. Data were then converted into 7-day averages of the daily maximum. Up to three levels of temperature criteria based on suitable temperature ranges, migration barriers, and lethality, derived from Washington State Department of Ecology (2002) were applied to each life stage to determine if temperature was a limiting factor. Temperature regimes in each reach were analyzed for potential impacts to the appropriate life stages for each priority species. Life stages included migration, holding, spawning, egg incubation, fry rearing, juvenile rearing, and outmigration. The life stages associated with overwintering were not evaluated as temperature was not considered to be limiting.

Temperature data, when available, were analyzed for impacts to priority species. If no temperature data were available for a reach, temperature assessments for the reach from literature were cited. Temperature criteria used in the analysis represented a suitable range of temperatures for a species and life stage to persist (WDOE 2002). Migration barrier criteria represented a range of stream temperatures at which a migrating adult fish would not attempt to migrate upstream. The lethality criterion is a single number at which exposure is instantly lethal to adults, or a range at which exposure over a period of 7 days is lethal to juveniles (WDOE 2002). Temperature profiles of the 7-day average of the daily maximum temperature data were made for the period of record available for each reach. Temperature criteria for each species and most life stages were overlaid onto the profiles to determine if temperatures were within a suitable range for the life stage.

Table 1. Walla Walla Basin spring Chinook life stage periodicity. Adapted from Mahoney et al. 2006, 2009, and 2011 and Mendel et al. 2007.

Life stage	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult spawning migration[1]												
Pre-Spawn holding												
Spawning[2]												
Incubation/emergence												
Juvenile rearing[3]												
Sub-adult migration and overwintering	O	O	O	O	O–D	D	D	D	D	D	D	D
Juvenile outmigration												

[1] Chinook return to Walla Walla River between April and July. Return above Nursery Bridge Dam (NBD) occurs around 1 May and peak return coincides with peak flow of approximately 300 cfs in mid-May. 95% of returns above NBD occur by 15 June (flow approximately 140 cfs). High temperatures may cause a migration bottleneck for late returning Chinook in the lower Walla Walla River (Mahoney et al. 2011). Chinook return in low numbers to the North Fork Touchet River (North Fork Touchet River and Wolf Fork Touchet River) and Mill Creek (Mendel et al. 2007).

[2] Chinook spawn in North Fork Touchet River, upper Mill Creek, upper Walla Walla River, and South Fork Walla Walla River (Mendel et al. 2007, Mahoney et al. 2006, 2009, and 2011).

[3] Juveniles spend 14–18 months in the upper mainstem Walla Walla River and its tributaries (Brian Mahoney, pers. comm., 22 February 2011).

D =Sub-adult (age 1+) disperse from upper mainstem Walla Walla River as far downstream as Lowden (Mahoney et al. 2011).

O =Sub-adult overwinter between Lowden and South Fork Walla Walla River (Mahoney et al. 2011). Less is known about overwintering in the Touchet River and Mill Creek.

Peak life stage timing.

Life stage present.

Table 2. Walla Walla Basin Bull Trout life stage periodicity. Adapted from Mahoney et al. 2006, 2009, and 2011; Mendel et al. 2007.

Life stage	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult spawning migration[1]												
Pre-Spawn holding[2]												
Spawning												
Incubation/emergence[3]												
Juvenile rearing[4]												
Adult migration and overwintering	D	D	D–Oa	D–Oa	Oa	Oa	Oa					
Sub-adult migration and overwintering	Os	Os	Os	Os	Os	Os	Os	Su	Su	Su	Su	Su

[1] Adults migrate from Mill Creek, mainstem Walla Walla River and North Fork Walla Walla River to spawn in the South Fork Walla Walla River. Peak migration above NBD is May to early June (Mahoney et al. 2011). Bull trout spawn in South Fork Touchet River, Wolf Fork, and Mill Creek (Mahoney et al. 2009).
[2] Bull trout hold in mainstem Walla Walla River downstream of the North Fork and South Fork (Mahoney et al. 2006).
[3] Incubation and emergence range 165–235 days (Buchanan et al. 1997).
[4] Parr stage last 2–3 years with little migration.

D =Adult downstream migration from South Fork Walla Walla River spawning grounds to overwintering grounds in mainstem Walla Walla River, South Fork Walla Walla River, North Fork Walla Walla River, and Mill Creek (Mahoney et al. 2011). Several adults detected in the preceding summer–winter in the Walla Walla River Basin have later been detected at McNary Dam and Priest Rapids Dam in the spring of the following year (Anglin et al. 2009). Many other adults were detected around Burlingame Dam and Oasis Road Bridge during winter (Anglin et al. 2009).

Oa =Adult overwintering in North Fork, South Fork, and mainstem Walla Walla rivers and Mill Creek (Mahoney et al. 2011). Less is known about adult overwintering in the Touchet River.

Os =Sub-adults migrate from the South Fork Walla Walla River in fall, winter, and spring, dispersing downstream to overwintering habitat (Mahoney et al. 2011). Less is known about subadult migration in the Touchet River.

Su =Sub-adults move into South Fork Walla Walla River for summer rearing habitat at the same time adults migrate upstream for spawning (Mahoney et al. 2011). Sub-adults in the Touchet River are found in the North Fork Touchet River, Wolf Fork Touchet River, Lewis Creek, and Spangler Creek (Mendel et al. 2007).

Peak life stage timing.

Life stage present.

Table 3. Walla Walla Basin summer steelhead life stage periodicity. Adapted from EES 2005, Mahoney et al. 2006, 2009, and 2011; Mendel et al. 2007.

Life stage	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Adult spawning migration[1]	▒	▒	▒	▒	■	■	■	■	▒			▒
Pre-Spawn holding			▒	▒	▒	▒	▒					
Spawning				▒	■	■	■	▒				
Incubation/emergence				▒	▒	■	■	■	▒	▒		
Juvenile rearing	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
Adult outmigration [2]						▒	■	■	▒			
Juvenile outmigration [3,4]	■	■	■	▒	▒	▒	■	■	▒			

1 Adult steelhead hold in Wallula Lake at mouth of Walla Walla River from September to November and begin to migrate upriver and disperse into tributaries in January. Peak migration is February–May (Mahoney et al. 2006).

2 Steelhead kelts rapidly leave spawning grounds from April–May (Mahoney et al. 2009).

3 WDFW enumerated juvenile outmigration at the Touchet River rotary screw trap (Oct. 2007–June 2008). Peak outmigration was in October, November, and December. Tagged juveniles were recaptured in the Walla Walla River at Oasis Road Bridge and in the Columbia River at McNary, John Day, and Bonneville dams (Mahoney et al. 2009).

4 CTUIR smolt traps at Joe West Bridge and the Lower Walla Walla River detected peak outmigration of steelhead from the Walla Walla River in April and May (Mahoney et al. 2011).

■ Peak life stage timing.
▒ Life stage present.

2.4 Limiting Factors Analysis

Flow prescriptions for the Walla Walla River, Mill Creek, and Touchet River basins were developed using a limiting factor analysis framework. A general conceptual model was developed to assess potential limiting factors in the river basins. Four broad categories of possible limiting factors were identified: channel condition, water quality, water temperature, and physical habitat condition (including adequate stream flow). The limiting factor analysis began with review of existing reports and incidental data and consultation with CTUIR staff and other local experts to make determinations on a reach-by-reach basis regarding possible limiting factors on the priority species and life stages that currently, or may in the future, utilize each reach. The limiting factor framework is illustrated as a flow chart in Figures A–1 to A–6 of Appendix A. Each potential limiting factor was considered for its possible effect on the priority species. Where a factor was considered potentially limiting in a river reach, it was noted in the limiting factors summary table (Appendix B) and associated documentation was compiled and cited, along with any notes as to the nature of the limitation.

Limiting factors of channel condition included levees and other bank hardening, reduction of floodplain connectivity, loss of channel length, in-channel dredging, substrate embeddedness, and a lack of riparian vegetation. Dissolved oxygen and pH levels measured during a TMDL study were the main components for assessing water quality limiting factors (Joy et al. 2007). Physical habitat and stream flow limiting factors included habitat quantity and quality, and adequacy of flow for specific life stages of primary species reported in the basin literature.

If temperature exceeded the upper limit of the criteria during the time period the critical life stage was expected to be in the reach, temperature was considered limiting and was identified as a potentially limiting factor. If the temperature exceeded the lower limit of the migration barrier or lethal criteria, temperature was considered limiting.

The fisheries flow assessment process required the identification of a critical life stage for one or more priority species in order to prescribe a flow for a particular reach. Critical life stages for the three priority species were identified in the limiting factors analysis (Appendix B). A ‘period of interest’ was defined for each life stage using the peak life stage timing from the species periodicity information in Table 1, Table 2, and Table 3. If a peak life stage had not been defined, then the period of interest was defined as the irrigation season (April–October). As a result of defining a period of interest, the following life stages were eliminated from consideration as critical and are therefore not considered in the limiting factor analysis: Chinook subadult migration, subadult and juvenile overwintering and juvenile outmigration, steelhead adult outmigration, juvenile and subadult overwintering; bull trout adult migration (post spawning), adult overwintering, and subadult migration and overwintering.

The severity and longevity of the impact of limiting factors on each life stage was assessed by reviewing the number of potential limiting factors that apply and the period of use by the priority species and life stage. For example, based on the critical timing of the migration window, low stream flow and high water temperatures were determined to affect adult Chinook migration in May and June more than steelhead juvenile rearing in Reach 4 of the Walla Walla River. The critical life stage of a species was then given a ranked priority for the period of interest. Rankings ranged from high to moderate to low in order to help set life stage priorities for instream flow setting purposes. Multiple species and life stages were identified in reaches with high species diversity (e.g., Walla Walla Reach 5). In these cases, recommended flows for reaches with multiple critical life stages were developed to ensure each life stage and species was provided with sufficient stream flow.

2.4.1 Flow Prescriptions for multiple critical life stages

Similarly ranked critical life stages and critical time periods frequently overlap within a reach (e.g., Walla Walla Reach 5). In these cases, priority was given to 1) life stages that CTUIR identified as a priority for flow prescriptions within a particular reach, 2) species and life stages that require more water based upon habitat/flow relationships, and 3) life stages representing desired future conditions in reaches where they are currently marginal or non-existent (e.g., spring Chinook rearing in Reach 3). Recommended flows for reaches with multiple critical life stages were developed to ensure each life stage and species was provided with sufficient flow.

2.4.2 Critical life stage identification by month

Many species and life stages of are found in a reach at a single time and require adequate flow and water quality. For purposes of instream flow setting a single species and life stage was identified for each reach. A set of guidelines were applied to identify CTUIR priority for critical life stages for each month using the species periodicity tables (Section 2.2) and limiting factors analysis in Appendix B, as well as consultation with the CTUIR.

2.4.2.1 Migration

1. Spring Chinook—the CTUIR have prioritized May, June and occasionally July as the critical time period for this life stage in the Walla Walla River and Mill Creek due to limited water quality and quantity during the migration period.
2. Steelhead—priority varies by subbasin and is determined by reach specific information supplied by CTUIR. In Mill Creek, the life stage is prioritized from February through March. In the Touchet River the life stage is prioritized in the upper watershed from February to March and is extended to April in Reach 2 and through May in Reach 1 to accommodate downstream migration. The most variation in priority for steelhead migration occurs in the Walla Walla River; late winter to early spring is the critical time period in upper reaches and tributaries and lower reaches the time period extends from late fall to early spring to accommodate fish that return earlier. Migration is prioritized in October through March in Pine, Dry, Blue, Couse, Yellowhawk and Cottonwood creeks. The CTUIR prioritize adult steelhead over juvenile steelhead in the early spring assuming adults have higher stream flow requirements than juveniles.
3. Bull trout—is prioritized in the North Fork of the Touchet River from June through August and in Touchet River Reach 1 in June.

2.4.2.2 Spawning

1. Spring Chinook—the CTUIR prioritize spawning in August and September in upper Mill Creek and upper Walla Walla River.
2. Steelhead—the CTUIR prioritize spawning in April and May in the tributaries, the Walla Walla basin upstream of Reach 4, and Mill Creek upstream of Reach 3 unless Chinook migration has been given priority in May. Spawning is prioritized in North and South Forks of the Touchet River in April and May.
3. Bull trout—spawning is prioritized in September and October in the North Fork of Touchet River and October in the South Fork Walla Walla River.

2.4.2.3 Juvenile rearing

1. Steelhead—CTUIR prioritize adults over juveniles in most cases, using the logic that larger fish require more water. Steelhead rearing is typically assigned greater volumes of water for rearing than other priority species by WDFW habitat suitability curves. Steelhead rearing was frequently identified as the critical life stage during periods when multiple priority species are rearing simultaneously. The assumption was made that if adequate water was available for steelhead, then spring Chinook and bull trout rearing needs would be satisfied. Steelhead rearing was given priority during winter months due to having the highest flow requirement of the three priority species.
2. Spring Chinook—rearing is assumed to be covered by steelhead juvenile rearing requirements.
3. Bull trout—rearing requirements are assumed to be covered by steelhead juvenile rearing requirements.

2.4.2.4 Flow continuation

No critical life stage is identified from July through February in Walla Walla Reach 1, Walla Walla Reach 2, Mill Creek Reach 2 and Touchet River Reach 1 due to little to no rearing occurring in these reaches. Flows in these reaches are based upon the continuation of flow prescriptions from the reach directly upstream.

2.5 Hydrology Data and Analysis

The complexity of setting flows to support the life histories of multiple priority species in three subbasins, as well as prescribing ecological flows, requires a hydrologic dataset broken down by reach. Flow data in the Walla Walla Basin are discontinuous and even the earliest records are presumed to reflect at least some altered hydrology. To create a continuous data set for the basin, stream flow records for the mainstem and major tributaries of the Walla Walla River, Mill Creek, and the Touchet River were obtained from the USGS and the Oregon Water Resources Department stream gage networks. Figure 4 shows the gages used for deriving reach-based datasets for the Walla Walla Basin.

The lack of mainstem flow data in the Walla Walla River required aggregating data from gaged tributary inflows, gaged irrigation diversions, and mainstem gages from the same time period to acquire a representative dataset for the mainstem reaches. In many cases, major tributaries did not have flow records available, or the records were of short duration. In tributaries where flow records are unavailable, synthesized datasets were created from nearby watersheds with similar basin characteristics (Appendix C). In tributaries where flow records are of short duration, datasets were created by correlating the existing flow record with that of a nearby gage, and extended to the necessary time period. See Appendix C for details about each flow record.

The mainstem flow datasets assume a principle of conservation of mass through the system, and it was assumed that all water from the reach above as well as flow contributions from tributaries remain in the river. Irrigation return flows are not separately accounted for using this methodology, since the original gaged irrigation diversion volumes were retained in the river. Daily means, monthly means and 80% exceedance flows were calculated for each reach for the same period of record 1952-1968 in order to have a comparable dataset throughout the Walla Walla Basin, and the information used in the flow prescription analysis.

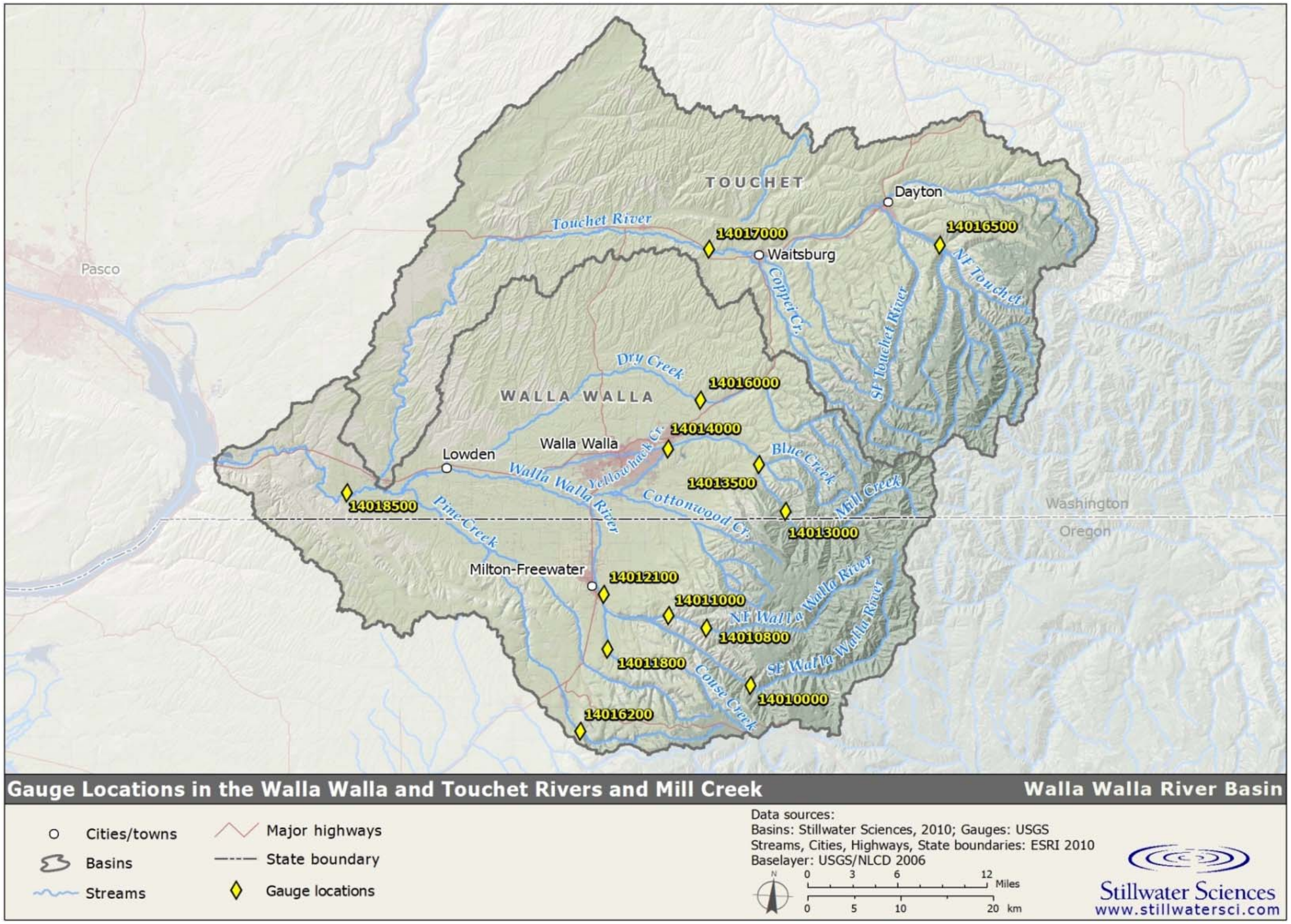

Figure 4. USGS gage locations in the Walla Walla and Touchet rivers and Mill Creek.

2.5.1 Flood frequency analyses

Flood frequency analyses were used to quantify the discharge associated with the 2- and 7-year recurrence interval flow for each reach and to identify a variable flow regime necessary to support ecologically based geomorphic functions. The 2-year recurrence interval flow is defined as the ‘bankfull or habitat maintenance’ flow. The majority of instream habitat creation and maintenance occurs during bankfull flows. At bankfull stage, the high shear stress of water interacts with areas of high roughness (woody debris and boulders) to create pools, sort gravels in riffles and increase variability in the channel margins. The 7-year recurrence interval flow is defined as the ‘riparian refreshment’ flow. The magnitude of the 7-year flow overtops stream banks that are not constricted by levees, maintaining dynamic riparian communities, recruiting large woody debris from stream banks, and preventing encroachment by woody species.

The record of mean daily annual peak flows was used to generate flow duration curves that approximate the true frequency curve of the underlying population of the annual flood peaks (note that the use of mean daily peak values, instead of instantaneous peak values, will under-represent the peak flow magnitude of an individual storm). High flow estimates (2- and 7-year recurrence intervals) were derived from the flow duration curves to prescribe a variable flow regime necessary to support ecologically-based geomorphic functions.

2.5.1.1 Walla Walla River

A daily ‘representative’ flow dataset was created for each reach in the Walla Walla River Basin by using mean daily flow values from the earliest overlapping period of record for all gages in the basin (1952-1968) excepting Yellowhawk Creek (1943-1951) (Table 4). Daily flow values were generally derived from the earliest period of record, which were assumed to best represent an undisturbed flow regime in the reach. However, many of the mainstem Walla Walla River reaches had anthropogenic alterations in the early 1900s, and the best historical data records for use in the analysis were from the mid-century. Therefore, at least some anthropogenic flow impairment was presumably occurring already. The datasets for each reach were developed by combining the flow values from the reach directly upstream, and adding major contributions from tributary inflows. Longer periods of record (Table 4) were used to calculate period of return for ecological flows, since these flows are higher (e.g., peaks) and are not as significantly affected by diversions.

Table 4. Gage number and period of record used to derive 'representative' flow in the Walla Walla River.

River reach	Flow contributions	Low flow period of analysis	High flow period of analysis	Gage numbers and data sources
South Fork Walla Walla River	South Fork Walla Walla	1952–1968	1908–2009	#14010000
North Fork Walla Walla River	North Fork Walla Walla—combined gage data to extend period of record at downstream gage #14011000	1952–1968	1931–2009	#14010800, #14011000
Walla Walla Reach 6	North Fork Walla Walla and South Fork Walla Walla data combined to derive Reach 6 hydrology	1952–1968	1931–2009	#14010000, #14010800, #14011000
Couse Creek	Couse Creek—period of record extended using Umatilla River above Meacham Creek, gage # 14012000 (Appendix C)	1952–1968	1934–2011	#14011800, #14020000
Walla Walla Reach 5	Sum of Reach 6 data and Couse Creek data	1952–1968	1934–1991	Gages listed for Reach 6 plus Couse Creek (Appendix C)
Cottonwood Creek	Cottonwood Creek data derived from Couse Creek (Appendix C)	1952–1968	1934-2011	Gages listed for Couse Creek (Appendix C)
Yellowhawk Creek	Mill Creek diversion at First Division Works	1943–1951	1940–1971	#14014000
Walla Walla Reach 4	Sum of Reach 5 and Cottonwood Creek data	1952–1968	1934–1991	Gages listed for Reach 5 plus Cottonwood Cr (Appendix C)
Walla Walla Reach 3	Sum of Reach 4 and Mill Creek Reach 1	1952–1968	1940–1971	Gages listed for Reach 4 plus #14013000
Dry Creek, (WA)	Dry Creek period of record extended using gage #14017000 Touchet River at Bolles (Appendix C)	1952–1968	1949–1989	#14016000, #14017000 (Appendix C)
Walla Walla Reach 2	Sum of Reach 3 and Dry Creek	1952–1968	1949–1971	Gages listed for Reach 3 plus Dry Creek #14016000 (Appendix C)
Pine Creek	Pine Creek, Dry Creek (OR) period of record extended using gage #14017000 Touchet River at Bolles (Appendix C)	1952–1968	1952–1989	#14016200 (Appendix C)
Walla Walla Reach 1	Sum of Reach 2, Pine Creek, Touchet River Reach 1	1952–1968	1952–1971	Gages listed for Reach 2 plus #14016200 and #14017000

2.5.1.2 Mill Creek

Discharge data from USGS Gage #14013000 (Mill Creek near Walla Walla, WA, in Reach 4 of Mill Creek) was intermittently in operation between 1913 and 1976. Data from USGS gages in Reach 2 #14013600 and Reach 3 #14015000 data were considered of inadequate quality for use in these analyses. The data spanning 1940–1971 plus water supply diversions for the City of Walla Walla (see Appendix C) were used as the base flow for Mill Creek Reaches 4 and 5. Blue Creek flow (see Appendix C) was added to the Reach 4 data for Mill Creek Reaches 1, 2, and 3. The Mill Creek dataset is undiminished by diversions to Yellowhawk Creek. The period of record used for the low flow and high flow calculations of Mill Creek was 1940–1971 (Table 5).

Table 5. Gage number and period of record used to derive 'representative' flow in Mill Creek.

River reach	Flow contributions	Low flow period of analysis	High flow period of analysis	Gage number and data sources
Mill Creek Reach 5	Upper Mill Creek plus average City of Walla Walla Diversion	1940–1971	1940–1971	#14013000, City of Walla Walla diversion
Mill Creek Reach 4	Reach 5	1940–1971	1940–1971	#14013000
Blue Creek	Blue Creek	1940–1971	1940–1971	#14013500 (Appendix C)
Mill Creek Reach 3	Sum of Reach 4 and Blue Creek	1940–1971	1940–1971	#14013000
Mill Creek Reach 2	Reach 3	1940–1971	1940–1971	#14013000
Mill Creek Reach 1	Reach 2	1940–1971	1940–1971	#14013000

2.5.1.3 Touchet River

Hydrologic data for the Touchet River is largely discontinuous or absent. Flow for the North Fork Touchet River is from USGS Gage #14016500. South Fork Touchet River flows were derived from flow in Dry Creek, WA using a basin scaling approach. South Fork Touchet River and Dry Creek have similar basin size, slope and precipitation regimes. North Fork Touchet River was rejected as a candidate for calculating South Fork flow using a basin scaling approach because the North Fork has relatively high summer base flows, whereas the limited gage data available for South Fork shows a reduced summer flow regime more similar to Dry Creek.

Touchet River Reach 1 flow is from USGS Gage #14017000 located at Bolles, WA, where the gage operated intermittently between 1924 and 1989. Touchet River Reach 2 flows were derived by subtracting Coppei Creek flows from Touchet River Reach 1. The available gage data for Coppei Creek (WDOE Gage #32G060, 2002-present) does not correspond to the period of record available for the mainstem Touchet River, and therefore flow for Coppei Creek was synthesized from Dry Creek data using a basin scaling method (Table 6). The sum of North Fork and South Fork Touchet River flow frequently exceeds the flow in Touchet River Reach 2. Comparison of gage data and literature review (Barber et al. 2001) shows that Reach 2 is a losing reach in the summer months. The period of record used for the low flow calculations spans 1952-1968 to correspond with the Walla Walla River analyses, and high flow calculations use of full period of record for each gage.

Table 6. Gage number and period of record used to derive 'representative' flow in the Touchet River.

River reach	Flow contribution	Low flow period of analysis	High flow period of analysis	Gage number and data sources
South Fork Touchet River	South Fork and Dry Creek	1952–1968	1949–1967	#14016000
North Fork Touchet River	North Fork and Wolf Fork	1952–1968	1941–1968	#14016500
Touchet River Reach 2	Touchet River Reach 1 minus Coppei Creek	1952–1968	1952–1989	#14017000 minus Coppei
Coppei Creek	Coppei Creek and Dry Creek	1952–1968	1949–1989	#14016000
Touchet River Reach 1	Reach 2 and Coppei Creek	1952–1968	1952–1989	#14017000

2.6 Instream Flow Setting Methods

Three methods were used to develop minimum flow prescriptions to support critical life stages of priority species, depending on data availability and site-specific conditions: Physical Habitat Simulation (PHABSIM), a modified Tennant Method, and the Toe-Width Method.

2.6.1 Physical habitat simulation

The PHABSIM suite of hydraulic models and habitat criteria are part of the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish and Wildlife Service (Bovee 1982, Bovee and Milhous 1978, Milhous et al. 1984), and are a widely used tool for developing instream flow recommendations. Several instream flow studies had been conducted in the project area (Barber et al. 2003, Barber et al. 2001, Caldwell et al. 2002), and data from these studies were used in the analysis.

Data from the Caldwell et al. (2002) study were updated in 2013 based on revised hydraulic modeling and amended habitat suitability criteria (HSC) developed by WDFW and WDOE. The amended HSC were based on recent data analysis by WDFW and WDOE showing variations in depth and velocity preferences by steelhead and bull trout juveniles depending on stream width (Beecher et al. 2013). As a result, the Washington State Instream Flow Study Guidelines are being amended to recommend one set of HSC for large streams (toe-width greater than 35 feet) and another set of HSC for small streams (toe-width less than 35 feet). The WDFW updated the weighted usable area (WUA) results presented in the Walla Walla IFIM Study (Caldwell et al. 2002), incorporating the updated HSC curves for large streams (toe-width greater than 35 feet) for priority species in the Walla Walla basin (Beecher et al. 2013).

WDFW and WDOE further amended HSC for all species by using a larger dataset than previous studies. This report incorporates the updated HSC for the priority species in the Walla Walla basin.

2.6.2 Modified Tennant method

A modified Tennant Method (Tessman 1980, Annear et al. 2004) that uses historical records of mean monthly and mean annual flows was used to prescribe flows for tributaries that did not have PHABSIM results: North Fork and South Fork Walla Walla, Couse Creek, Cottonwood Creek, Blue Creek, Dry Creek and Pine Creek. The approach results in flows that vary by month, and the calculations take into consideration the mean monthly flow variation, how relative "dry" or "wet" the month is, and how the month compares to the overall variance in flow throughout the year (Table 7). This approach tends to generate a natural hydrographic pattern, and adjusts for transitional periods (i.e., fall and spring) between wet and dry seasons.

Table 7. Modified Tennant calculations (Tessman 1980, Annear et al. 2004).

Situation	Minimum monthly flow
MMF[a] < 40% MAF[b]	MMF
MMF > 40% MAF and, 40% MMF < 40% MAF	40% MAF
40% MMF > 40% MAF	40% MMF

[a] MMF = mean monthly flow
[b] MAF = mean annual flow

2.6.3 Toe-Width method

The Toe-Width method was used to calculate flows in Yellowhawk Creek (Swift 1976), since sufficient data for the PHABSIM and a modified Tennant Method were unavailable. Flow in Yellowhawk Creek is highly modified from historical patterns and is controlled by the Army Corps of Engineers via diversions from Mill Creek. Discharge and cross sectional area data collected at the mouth of Yellowhawk Creek were acquired from WDOE (2002) and Walla Walla Basin Watershed Council (2010-2012). Monthly data were divided by critical life stages of steelhead, spawning and rearing, identified in the limiting factors analysis. Discharge and toe-width data were used to calculate optimum flows for each life stage under current channel configuration conditions.

2.7 Minimum Flow Analysis Procedure

A minimum flow analysis matrix was developed for each basin that applied a series of criteria or "rules" in a stepwise fashion to develop preliminary flow targets and final flow prescriptions by month for each priority species and life stage in each stream reach. The analysis matrix used available PHABSIM data for the Walla Walla River, Mill Creek, and Touchet River watersheds (Barber et al. 2001, Barber et al. 2003, Caldwell et al. 2002) where available, results of the modified Tennant method and other hydrologic analysis (particularly in reaches or tributaries with no PHABSIM data), and/or "toe-width" data on channel configuration (i.e., in Yellowhawk Creek where there was no PHABSIM data and limited hydrologic information). The final flow prescriptions considered inflows on a reach-specific basis; natural flow availability; habitat, hydrologic, or channel conditions; and flow prescription continuity from upstream to downstream.

2.7.1 Preliminary flow targets

The preliminary flow targets were developed in a stepwise fashion beginning at the top of each watershed, based on the availability of data in the reach and the nature of the WUA versus flow relationship (if available) and other data for the species and life stage. Data "priorities" were as follows.

A. If PHABSIM data were available for the reach, and the WUA versus flow relationship displayed a modal or distinct curvilinear shape, the preliminary flow target was based on 80 percent of the maximum WUA. The 80-percent threshold is widely used as a guideline for flow prescriptions, since it provides: (a) a majority of the maximum WUA; (b) generally occurs at or above the inflection point of the WUA versus flow curve, thereby maximizing WUA per unit of flow; (c) avoids issues associated with selecting anomalous or outlier peaks in the WUA versus flow relationship (particularly where the curve flattens out); and (d) appropriately recognizes that specification of flows much closer to the "maximum" WUA can be misleading because they are likely statistical or modeling artifacts that can be outside the bounds of the precision of the model in the first place. PHABSIM data used in the analysis are presented in Appendix D.
B. Where PHABSIM results did not display a modal or distinct curvilinear shape, and wetted area versus flow data were available, the preliminary flow target considered the inflection point in the wetted area (or WUA) versus flow curve. This approach parallels aspects of the WUA curve approach described above in step 'A', and reflects the fact that once the active channel is fully inundated (helping to maximize food production and potential habitat area), subsequent increases in flow tend to provide less additional habitat per unit increase in flow. Unlike the WUA approach, however, the wetted width calculation does not consider the *quality* of the habitat, but rather just its quantity.
C. In cases where no PHABSIM or wetted area data were available for a reach, but were available for adjacent reaches, PHABSIM-based results from the adjacent reach were used as surrogate target flows.
D. In "headwater" streams or smaller tributaries with no PHABSIM data, prescribed flows were developed using a modified Tennant approach (Tessman 1980, Annear et al. 2004). This approach is hydrologically based, and considers both the representative or "historical" mean monthly flows, as well as mean annual flows.
E. If there were insufficient hydrologic data to reliably apply a modified Tennant approach (i.e., Yellowhawk Creek), the toe-width method (Swift 1976) was applied.

2.7.2 Flow prescriptions

Using the data priorities described above, the following rules were applied to develop flow prescriptions in each reach or major tributary.

Rule #1: For stream reaches using a modified Tennant method, the flow prescription was set at that modified Tennant flow.

Rule #2: Flow prescriptions from upstream reaches or tributaries were summed to provide an additive "prescribed inflow" to each reach.

Rule #3: Prescribed inflow was compared to WUA thresholds for the reach.

a. If prescribed inflows were less than 80% of maximum WUA ("maxWUA") on the ascending limb of the WUA-flow curve, the 80% maxWUA flow was the preliminary target flow. MaxWUA data for each reach is found in Appendix D, Table D-1.
b. If prescribed inflows were above the 80% maxWUA flows on the ascending limb of the WUA-flow curve, the prescribed inflow was used as the preliminary target flow (to allow for flow variation above

minimum habitat values, and/or flow continuity with upstream reaches).

Rule #4: In order to constrain preliminary flow targets (if necessary) to flow ranges that can be reasonably expected to naturally occur (e.g., be hydrologically likely), they were compared to the 80% exceedance flow for the reach (i.e., the flow that occurred at least 80% of the time under historical conditions). The lower of the preliminary target flow or the 80% exceedance flow was selected as the prescribed flow (i.e., the flow prescription was "capped" at the 80% exceedance flow). Exceedance flows are found in Appendix D, Table D-2.

Rule #5: The flow prescription in a reach was no lower than the prescribed inflow to the reach (regardless of the WUA-flow relationship, associated changes in the priority species or life stages, or the 80% exceedance flow).[1]

Rule #6: The following exception was applied to the above rules:

a. Due to potential flow-related anadromous fish migration barriers between March and June, the 80% ascending maxWUA cap in Rule #3(a) was not applied in those months, and flow prescriptions could range up to the 80% maxWUA descending limb flow (Rule #4 regarding the 80% exceedance flow and Rule #5 regarding inflow still apply). This exception provides for springtime flow peaks that help initiate migration, facilitate passage, and correspond with periods of potential floodplain inundation.

The above rules were programmed into an Excel spreadsheet that facilitated the development of prescriptions that "flowed" down from the top of the watershed. Each reach receives flow from the reach above, prescribed flows in the next downstream reach are augmented by accretion and/or adjustments based on their WUA-flow relationships and priority species and life stages, and the flow prescription is passed to the next downstream reach.

The following narrative and sample results in Table 8 provide examples of the logic structure and flow using these methods.

[1] In a few cases, prescribed inflows to a reach may slightly exceed the 80% exceedance flow for the reach due to inconsistencies in the quantity or precision of hydrologic data available for each reach, or differences in "data priorities" that were used upstream. These variations have no significant effect on the overall flow prescriptions.

Table 8. Sample data for the logic structure and flow prescriptions for reaches of the Walla Walla River.

Reach	Metric	Flow (cfs) by month (October)	Data priority and rules	Flow (cfs) by month (May)	Data priority and rules
NFWW	Modified Tennant Flow	11	D, 1	43	D, 1
SFWW	Modified Tennant Flow	70	D, 1	122	D, 1
WWR6	Prescribed Inflow	81	2	165	2
WWR6	Priority Species & Life Stage	SH Juvenile/ Fry rearing	--	Chinook Migration	--
WWR6	WWR5 80% maxWUA-ascending	90	A, C	48	A, C
WWR6	WWR5 80% maxWUA-descending	325	A, C	218	A, C
WWR6	Preliminary Target Flow	90	A, 3a	218	A, 6
WWR6	WWR6 80% Exceedance Flow	98	--	279	--
WWR6	Final Prescribed Flow	90	3a	218	6
Couse Creek	Modified Tennant Flow	1	D, 1	12	D, 1
WWR5	Prescribed Inflow	91	2	230	2
WWR5	Priority Species & Life Stage	SH Juvenile/Fry rearing	--	Chinook Migration	--
WWR5	80%WUA-ascending	90	A	48	A
WWR5	80%WUA-descending	325	A	218	A
WWR5	Preliminary Target Flow	91	A, 3b	230	A, 5
WWR5	WWR5 80% Exceedance Flow	100	--	272	--
WWR5	Final Prescribed Flow	91	3b, 5	230	3b, 5

An example of where WUA results drive the flow prescription is as follows:

1. The north and south forks of the Walla Walla River have modified Tennant flow prescriptions for October of 11 and 70 cfs, respectively (Table 8), based on their hydrology, resulting in an additive prescriptive inflow to Walla Walla Reach 6 of 81 cfs, based on Rule 2 above.
2. The WUA-flow relationship applied to Walla Walla Reach 6 (from adjacent Reach 5, per data priority 'C') has an 80% maxWUA ascending value of 90 cfs, and an 80% maxWUA descending value of 325 cfs for the selected priority species and life stage (steelhead rearing).
3. The preliminary target flow is 90 cfs, based on the WUA results and Rule 3(a) above.
4. The 80% exceedance flow is 98 cfs, which is greater than the preliminary flow target, indicating that target flows in October are hydrologically likely (Rule #4).
5. The Walla Walla Reach 6 flow prescription is 90 cfs, based on Rule 3a above, and in compliance with Rule #5 and without any exceptions per Rule #6.

An example of where prescribed inflows drive the flow prescription is provided below.

1. Per Table 8, prescriptive inflow to Walla Walla Reach 5 is 91 cfs in October (the sum of the 90 cfs flow prescription from Walla Walla Reach 6, and the 1 cfs inflow from Couse Creek) (Rule #2).
2. The WUA-flow relationship for Walla Walla Reach 5 has an 80% maxWUA value of 90 cfs for the selected priority species and life stage (steelhead rearing).
3. The preliminary target flow is 91 cfs, based on the prescribed inflow and Rule 3(b) above.
4. The 80% exceedance flow is 100 cfs (above the preliminary target flow).
5. The flow prescription is 91 cfs, based on Rule #5 above, without any exceptions per Rule #6.

A final example (Table 8) of where the flow prescription is driven by the WUA result under spring migration flow conditions is as follows.

1. Additive prescribed inflow to Walla Walla Reach 6 is 165 cfs in May (the sum of the 122 cfs flow prescription from the South Fork and the 43 cfs inflow from the North Fork) (Rule #2).
2. The WUA-flow relationship for Walla Walla Reach 6 has an 80% maxWUA value of 48 cfs for the selected priority species and life stage (Chinook migration), and 80% descending limb maxWUA of 218 cfs.
3. The preliminary target flow would be 165 cfs, based on the WUA results and the prescribed inflows, per Rule 3(b). However, the Rule 6 exception applies because May is in the spring migration period, and the preliminary target flow is 218 cfs.
4. The 80% exceedance flow is 279 cfs (above the preliminary target flow), so preliminary target flows are typically available.
5. The flow prescription is 218 cfs, based on Rule 4 above, in compliance with Rule 5, and applying the Rule 6 exception.

3 RESULTS

3.1 Hydrology

Mean monthly 'representative' flows and flood flow recurrences are presented in Table 9 and Table 10 respectively. The hydrology datasets used to calculate these values use 'representative' conditions as described in Section 2.5. Review of hydrologic records shows that the approximate minimum duration for a 2-year flow event is a one day and the 7-year flow event is a 3-day duration. The duration of each flood event includes the rising limb, the peak, and the descending limb. The peak flows presented in Table 10 are based on daily average peak flow data.

Table 9. Mean monthly flow calculated from 'representative' conditions for study reaches in the Walla Walla River, Mill Creek, and Touchet River basins.

Reach	Period of analysis	Mean monthly flow (WY Oct–Sept) (cfs)											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
South Fork Walla Walla	1952–1968	114	132	175	178	202	193	275	295	196	122	107	107
North Fork Walla Walla	1952–1968	11	21	52	60	76	68	120	93	30	7	4	6
Walla Walla Reach 6	1952–1968	126	153	227	238	278	261	394	388	225	129	111	112
Couse Creek	1952–1968	1	9	24	30	37	45	63	43	12	1	0.4	0.4
Walla Walla Reach 5	1952–1968	127	157	242	254	298	281	433	415	233	130	111	1
Cottonwood Creek	1952–1968	1	5	14	17	21	27	39	30	9	1	0.3	0.3
Yellowhawk Creek	1943–1951	34	54	60	38	48	59	68	62	51	29	18	19
Walla Walla Reach 4	1952–1968	129	163	267	281	333	315	495	455	244	131	112	113
Mill Creek Reach 5	1940–1971	56	87	129	145	161	160	193	157	95	59	50	50
Mill Creek Reach 4	1940–1971	56	87	129	145	161	160	193	157	95	59	50	50
Blue Creek	1940–1971	3	10	21	31	33	34	31	16	7	1	1	1
Mill Creek Reach 3	1940–1971	58	97	150	176	194	194	225	172	102	61	51	51
Mill Creek Reach 2	1940–1971	58	97	150	176	194	194	225	172	102	61	51	51
Mill Creek Reach 1	1940–1971	58	97	150	176	194	194	225	172	102	61	51	51
Walla Walla Reach 3	1952–1968	189	249	421	452	525	498	720	618	335	190	163	165
Dry Creek	1952–1968	4	10	27	41	51	48	43	25	11	3	2	2
Pine Creek	1952–1968	1	4	14	25	27	27	27	12	3	0.4	0.1	0.1
Walla Walla Reach 2	1952–1968	194	260	448	486	569	540	764	641	343	192	164	167
South Fork Touchet River	1952–1968	4	9	24	37	46	43	39	22	10	2	1	2
North Fork Touchet River	1952–1968	51	82	148	142	184	170	211	173	93	52	45	45
Touchet River Reach 2	1952–1968	71	123	255	357	397	398	394	261	136	51	36	43
Coppei Creek	1952–1968	3	8	21	31	39	37	33	19	9	2	1	2

Reach	Period of analysis	Mean monthly flow (WY Oct–Sept) (cfs)											
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Touchet River Reach 1	1952–1968	75	131	275	388	433	433	426	280	145	53	38	44
Walla Walla Reach 1	1952–1968	262	384	748	836	983	936	1225	941	474	240	201	210

Table 10. Flow values associated with the 2- and 7-year recurrence interval flows.

Reach	Period of analysis	2-yr recurrence interval flow[1] (cfs)	7-yr recurrence interval flow[1] (cfs)
North Fork Walla Walla	1931–2009	406	555
South Fork Walla Walla	1908–2009	600	820
Walla Walla Reach 6	1931–2009	1,005	1,360
Couse Creek	1934–2011	356	918
Walla Walla Reach 5	1934–2009	1,151	1,558
Cottonwood Creek	1934–2011	582	1,238
Walla Walla Reach 4	1934–2009	1,374	1,905
Mill Creek Reach 5	1940–1971	630	995
Mill Creek Reach 4	1940–1971	630	995
Blue Creek	1940–1971	494	1,023
Mill Creek Reach 3	1940–1971	801	1,170
Mill Creek Reach 2	1940–1971	801	1,170
Mill Creek Reach 1	1940–1971	801	1,170
Walla Walla Reach 3	1940–1971	2,015	3,571
Dry Creek	1949–1989	1,094	2,736
Walla Walla Reach 2	1949–1971	2,205	3,571
Pine Creek	1952–1989	1,234	3,486
North Fork Touchet River	1941–1967	700	1,300
Touchet Reach 2	1952–1989	1,591	2,636
Coppei Creek	1952–1989	176	314
Touchet Reach 1	1952–1989	1,780	2,850
Walla Walla Reach 1	1952–1968	3,883	6,706

[1] Minimum duration for 2-year recurrence interval flow is 1 day; minimum duration for a 7-year recurrence interval flow is 3 days.

3.2 Identification of priority species and life stage by month

Instream flow setting requires the identification of a priority species and life stage in monthly time steps. Table 11 presents a summary of the priority species and critical life stages identified using guidelines set out in Section 2.4.2, subbasin species periodicity charts in Section 2.2, and results from limiting factors analysis in Appendix B. An ‘x’ in a column corresponds to the life stage and species selected for setting flows in a particular month in the identified reach. Life stages identified in Appendix B are correlated to life stages commonly referred to in the mid-Columbia River basin in Appendix B, Table B-1.

Example of identifying species and life stage by month: Walla Walla Reach 6—May, June and July

1. Identify priority species and life stage: The limiting factors analysis identified multiple life stages of each priority species as impacted by low flows, with habitat and temperature issues in WWR6 (Appendix B). For example: Spring Chinook migration, holding, spawning and rearing, bull trout migration and rearing and steelhead trout migration spawning and rearing were all given high priority in the LFA results.
2. Filter species and life stage by time period: Using the species periodicity charts in Section 2.2, life stage was further refined by narrowing down the time period of interest. This information is also summarized in Appendix B. For example: Spring Chinook migration is identified as high priority in May, June and July. Bull trout migration is a high priority in May and June. Steelhead spawning is identified as a high priority in May. Each species rears year-round in WWR6.
3. Apply guidelines in Section 2.4.2 . Each subsection addresses a life stage and identifies priority time periods and species within reaches in the Walla Walla basin. Example: (Section 2.4.2.1 Migration 1)—the CTUIR have prioritized May, June and occasionally July as the critical time period for spring Chinook migration in the Walla Walla River and Mill Creek. The result is that spring Chinook migration is identified as the life stage for which instream flows are prescribed in WWR6 for May, June and July (Table 11).

Table 11. Priority species and life stages identified by month for flow prescriptions.

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
North Fork Walla Walla	Steelhead	SH Adult migration						x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x	x				x	x	x	x
South Fork Walla Walla	Chinook	CS Adult migration/holding									x	x		
		CS Spawning											x	x
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning	x											
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration				x	x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing		x	x									

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Walla Walla River Reach 6 (Below North Fork/South Fork confluence)	Chinook	CS Adult migration/holding								x	x	x		
		CS Spawning											x	x
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration				x	x	x						
		SH Spawning							x					
		SH Juvenile/Fry rearing	x	x	x									
Couse Creek	Steelhead	SH Adult migration						x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x	x				x	x	x	x
Walla Walla River Reach 5 (Below Milton Freewater)	Chinook	CH Adult migration								x	x			
		CH Spawning												
		CH Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration						x						
		SH Spawning							x					
		SH Juvenile/Fry rearing	x	x	x	x	x					x	x	x

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cottonwood Creek (Tributary to Yellowhawk Creek)	Steelhead	SH Adult migration					x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x					x	x	x	x
Yellowhawk Creek	Chinook	CH Adult migration												
		CH Spawning												
		CH Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration					x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x					x	x	x	x
Walla Walla River Reach 4 (Below Yellowhawk Creek)	Chinook	CH Adult migration								x	x			
		CH Spawning												
		CH Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration					x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing	x	x	x	x						x	x	x

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Walla Walla River Reach 3 (Below Mill Creek)	Chinook	CH Adult migration								x	x			
		CH Spawning												
		CH Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration		x	x	x	x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing	x									x	x	x
Dry Creek	Steelhead	SH Adult migration	x	x	x	x	x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing									x	x	x	x
Walla Walla River Reach 2 (Below Dry Creek)	Chinook	CH Adult migration								x	x			
		CH Spawning												
		CH Juvenile/Fry rearing										fc	fc	fc
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration	x	x	x	x	x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing												

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Pine Creek (Tributary to WW Reach 2)	Steelhead	SH Adult migration	x	x	x	x	x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing									x	x	x	x
Walla Walla River Reach 1 (Below Touchet Confluence)	Chinook	CH Adult migration								x	x			
		CH Spawning												
		CH Juvenile/Fry rearing										fc	fc	fc
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration	x	x	x	x	x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing												
Mill Creek Reach 5	Chinook	CS Adult migration/holding								x	x	x		
		CS Spawning											x	x
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration					x	x						
		SH Spawning							x					
		SH Juvenile/Fry rearing	x	x	x	x								

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Mill Creek Reach 4 (Below Walla Walla Diversion Dam)	Chinook	CS Adult migration/holding								x	x	x		
		CS Spawning											x	x
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
		BT Juvenile/Fry rearing												
	Steelhead	SH Adult migration					x	x						
		SH Spawning							x					
		SH Juvenile/Fry rearing	x	x	x	x								
Blue Creek	Steelhead	SH Adult migration					x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x					x	x	x	x
Mill Creek Reach 3 (Below Blue Creek confluence)	Chinook	CS Adult migration								x	x			
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration					x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing	x	x	x	x							x	x	x

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Mill Creek Reach 2 (Below Bennington Dam)	Chinook	CS Adult migration								x	x			
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration					x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing	x	x	x	x						fc	fc	fc
Mill Creek Reach 1 (Below Gose Street)	Chinook	CS Adult migration								x	x			
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration					x	x	x					
		SH Spawning												
		SH Juvenile/Fry rearing	x	x	x	x						x	x	x

River and reach	**Species**	**Life stage**	**Critical time period for priority species and life stages for flow prescription**											
			Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
North Fork Touchet River	Chinook	CS Adult migration / holding												
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration/holding									x	x	x	
		BT Spawning	x											x
		BT Juvenile rearing												
	Steelhead	SH Adult migration					x	x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing		x	x	x								
South Fork Touchet River	Chinook	CS Adult migration												
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration					x	x			x			
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x						x	x	x

River and reach	Species	Life stage	Critical time period for priority species and life stages for flow prescription											
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Touchet River Reach 2 (below Forks)	Chinook	CS Adult migration												
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration												
		BT Spawning												
	Steelhead	SH Adult migration					x	x	x	x				
		SH Spawning												
		SH Juvenile/Fry rearing	x	x	x	x					x	x	x	x
Coppei Creek	Steelhead	SH Adult migration						x						
		SH Spawning							x	x				
		SH Juvenile/Fry rearing	x	x	x	x	x				x	x	x	x
Touchet River Reach 1 (below Coppei Creek confluence)	Chinook	CS Adult migration												
		CS Spawning												
		CS Juvenile/Fry rearing												
	Bull Trout	BT Adult migration									x			
		BT Spawning												
	Steelhead	SH Adult migration					x	x	x	x				
		SH Spawning												
		SH Juvenile/Fry rearing	x	x	x	x						fc	fc	fc

Life stage present

"x" indicates species and life stage identified for flow prescription for each month

"fc" indicates flow continuation

The sections below describe the rationale and results for minimum flow prescriptions for priority species, and also identify the ecological flow regime (2- and 7-year recurrence intervals) for each reach.

3.3 Walla Walla River

3.3.1 South Fork Walla Walla River

The South Fork Walla Walla River serves as a core spawning area for Spring Chinook salmon (Mahoney et al. 2011) and is heavily used by bull trout in the Walla Walla Basin (Budy et al. 2007). The CTUIR fish holding facility is located on the South Fork. The South Fork Walla Walla River supports all three priority salmonid species, and is utilized for holding, spawning, and rearing. The primary limiting factors identified in this reach are low minimum flows and high water temperatures that cause impaired habitat suitability in some portions of the reach; there are no data suggesting significant water quality or channel condition impairment (Appendix B). Spring Chinook migration and spawning are the priority life stages from June through September and bull trout spawning is the priority in October (Table 11). Prescriptive flows in this reach are a result of applying hydrologic criteria using a modified Tennant Method (Appendix D, Table D-3), as described in Section 2.6.2; the results are presented in Table 12. The flow prescription in this, and all downstream reaches, is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less, since very dry year conditions (e.g., >80% exceedance) could preclude meeting the target prescription.

The magnitude and duration of exceedance of water temperature thresholds (Appendix E, Figure E–11) in this reach during the summer rearing season, and during Chinook and bull trout spawning periods are expected to decrease as a result of this flow prescription, compared to current conditions.

In addition to the minimum flow prescriptions presented in Table 12 approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 11. Based on gage data spanning 1908–2009, the 2-year recurrence interval flow is 600 cfs and the 7-year recurrence interval flow is 820 cfs.

Table 12. Prescriptive flows for the Walla Walla River basin.

Reach	Metric	Minimum flows (cfs) by month											
		Oct[1]	**Nov[1]**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul[1]**	**Aug[1]**	**Sep[1]**
North Fork Walla Walla River—NFWW	Modified Tennant	11	21	21	27	30	38	52	43	21	11	6	7
South Fork Walla Walla River—SFWW	Modified Tennant	70	70	70	70	74	85	111	122	82	70	70	70
Walla Walla Reach 6—WWR6	Additive Prescribed Inflow	81	91	91	97	104	123	163	165	103	81	76	77
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	SH Spawning	CH Adult Migration / Holding	CH Adult Migration / Holding	CH Adult Migration / Holding	CH Adult Spawning	CH Adult Spawning
	WWR5 80%WUA-ascending	90	90	90	65	65	65	65	48	48	48	48	48
	WWR5 100%WUA peak	325	325	325	150	150	150	150	80	80	80	80	80
	WWR5 80%WUA-descending	325	325	325	325	325	325	325	218	218	218	218	218
	Preliminary Target Flow	90	91	91	97	104	325	325	218	218	81	76	77
	WWR6 80% Exceedance Flow	98	110	122	136	150	180	281	279	151	107	97	96
	Prescribed Flow	**90**	**91**	**91**	**97**	**104**	**180**	**281**	**218**	**151**	**81**	**76**	**77**
Couse Creek	Modified Tennant	1	5	6	7	9	11	16	12	5	1	0.3	0.3
Walla Walla Reach 5—WWR5	Additive Prescribed Inflow	91	96	97	105	112	191	297	230	156	82	77	77
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Spawning	CH Adult Migration / Holding	CH Adult Migration / Holding	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	80%WUA-ascending or inflection	90	90	90	90	90	65	65	48	48	90	90	90
	100%WUA peak	325	325	325	325	325	150	150	80	80	325	325	325
	80%WUA-descending	325	325	325	325	325	325	325	218	218	325	325	325
	Preliminary Target Flow	91	96	97	105	112	325	325	230	218	90	90	90
	WWR5 80% Exceedance Flow	100	112	125	139	159	197	296	272	151	108	98	92
	Prescribed Flow	**91**	**96**	**97**	**105**	**112**	**197**	**297**	**230**	**156**	**90**	**90**	**90**
Cottonwood Creek	Modified Tennant	1	9	9	12	15	18	25	17	9	1	0	0
Yellowhawk Creek	Toe Width	21	15	15	18	45	45	42	38	15	18	9	15

Reach	Metric	Minimum flows (cfs) by month											
		Oct[1]	**Nov[1]**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul[1]**	**Aug[1]**	**Sep[1]**
Walla Walla Reach 4—WWR4	Additive Prescribed Inflow[2]	92	105	106	117	127	215	322	247	165	91	90	90
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	80%WUA-low Q	60	60	60	60	107	107	107	102	102	60	60	60
	100%WUA Q	150	150	150	150	175	175	175	150	150	150	150	150
	80%WUA-high Q	400	400	400	400	265	265	265	220	220	400	400	400
	Preliminary Target Flow	92	105	106	117	127	265	322	247	220	91	90	90
	WWR4 80% Exceedance Flow	100	113	126	143	166	211	324	288	154	109	98	97
	Prescribed Flow	**92**	**105**	**106**	**117**	**127**	**215**	**322**	**247**	**165**	**91**	**90**	**90**
Mill Creek Reach 1—MCR1	Prescribed Mill Ck Inflow	46	55	64	74	88	104	149	110	72	52	45	45
Walla Walla Reach 3—WWR3	Additive Prescribed Inflow	138	160	170	191	215	319	471	357	237	143	135	135
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	80%WUA-low Q	130	80	80	80	80	80	80	68	68	130	130	130
	100%WUA Q	350	150	150	150	150	150	150	110	110	350	350	350
	80%WUA-high Q	350	265	265	265	265	265	265	179	179	350	350	350
	Preliminary Target Flow	138	160	170	191	215	319	471	357	237	143	135	135
	WWR3 80% Exceedance Flow	144	166	187	214	265	306	497	438	229	163	143	143
	Prescribed Flow	**138**	**160**	**170**	**191**	**215**	**319**	**471**	**357**	**237**	**143**	**135**	**135**
Dry Creek	Modified Tennant	4	9	11	17	19	19	17	10	9	3	2	2
Walla Walla Reach 2—WWR2	Additive Prescribed Inflow	142	169	180	208	235	338	488	367	246	146	137	137
	Priority Species & Life Stage	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	Flow continuation	Flow continuation	Flow continuation
	WWR3 80%WUA-low Q	80	80	80	80	80	80	80	68	68	130	130	130
	WWR3 100%WUA Q	150	150	150	150	150	150	150	110	110	350	350	350
	WWR3 80%WUA-high Q	265	265	265	265	265	265	265	179	179	350	350	350
	Preliminary Target Flow	142	169	180	208	235	338	488	367	246	146	137	137
	WWR2 80% Exceedance Flow	156	173	260	264	349	379	645	641	380	245	220	224
	Prescribed Flow	**142**	**169**	**180**	**208**	**235**	**338**	**488**	**367**	**246**	**146**	**137**	**137**
Touchet River Reach 1—TR1	Touchet River Prescribed Inflow	48	64	82	102	152	212	236	157	64	36	26	33
Pine Creek	Modified Tennant	1	4	6	10	11	11	11	5	3	0	0	0

Reach	Metric	Minimum flows (cfs) by month											
		Oct[1]	**Nov[1]**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul[1]**	**Aug[1]**	**Sep[1]**
Walla Walla Reach 1—WWR1	Additive Prescribed Inflow	190	237	268	320	398	561	735	529	313	183	163	170
	Priority Species & Life Stage	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	Flow continuation	Flow continuation	Flow continuation
	WWR3 80%WUA-low Q	80	80	80	80	80	80	80	68	68	130	130	130
	WWR3 100%WUA Q	150	150	150	150	150	150	150	110	110	350	350	350
	WWR3 80%WUA-high Q	265	265	265	265	265	265	265	179	179	350	350	350
	Preliminary Target Flow	190	237	268	320	398	561	735	529	313	183	163	170
	WWR1 80% Exceedance Flow	208	237	269	347	452	526	775	648	294	203	179	180
	Prescribed Flow	**190**	**237**	**268**	**320**	**398**	**561**	**735**	**529**	**313**	**183**	**163**	**170**

[1] Or natural inflow, whichever is less.
[2] Yellowhawk Creek flows not summed as part of the additive prescribed inflow to Walla Walla Reach 4. See explanatory text in Section 3.3.7.

3.3.2 North Fork Walla Walla River

The North Fork Walla Walla River has much lower flows than the South Fork, and is primarily used as steelhead rearing habitat (Table 11). There is likely insufficient flow at some times of the year to actually “optimize” conditions for the species of interest, but ensuring that the North Fork has sufficient flow to support the various species and make a proportional contribution to habitat area in the watershed will provide benefits to the priority species. As with the South Fork, the flow prescription for the North Fork is based a hydrologic assessment using a modified Tennant Method (Appendix D, Table D-3). This prescription is presented in Table 12.

In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1931–2009, the 2-year recurrence interval flow is 406 cfs and the 7-year recurrence interval flow is 555 cfs.

3.3.3 Reach 6

The primary limiting factors in this reach are high water temperatures and low minimum flows that cause low habitat suitability, although altered channel conditions limit habitat suitability as well (Appendix B). Spring Chinook migration, holding and spawning are a priority from May through September, steelhead juvenile rearing is a priority October through December and steelhead migration and spawning are a priority January through April (Table 11). Prescriptive flows in this reach are based on a combination of PHABSIM results from Reach 5 downstream, inflows from the upstream reaches, and hydrologic (80% exceedance) constraints, since PHABSIM and wetted area data are not available in Reach 6. Minimum flows are prescribed to meet requirements for various life stages of both steelhead and salmon (Table 12).

The magnitude and duration of exceedance of water temperature thresholds (Appendix E, Figures E–7 and E–8) in this reach during the summer rearing and Chinook and bull trout spawning periods are expected to decrease as a result of this flow prescription, compared to current conditions.

In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1931–2009, the 2-year recurrence interval flow is 1,005 cfs and the 7-year recurrence interval flow is 1,360 cfs.

3.3.4 Couse Creek

Couse Creek is a tributary to the Walla Walla River draining 24.7 square miles in Oregon (Stetson Engineers 2012). Peak runoff for Couse Creek generally occurs in April and May, and the low flow period extends from July through October. Couse Creek is a large tributary to the upper Walla Walla River and supports native redband trout and summer steelhead spawning and rearing. Couse Creek is the terminal or upstream destination for steelhead tagged in the lower, middle and upper Walla Walla River (Mahoney 2006). Steelhead spawner surveys (2001-2007) have reported redds each year except 2001 (Mahoney 2006, Mahoney 2009); steelhead redd density was 4.4 (+/- 3.17) redds per km in a 25.6 km index reach over the same time period (Mahoney 2008). Age class 0+ and 1+ steelhead have been found in Couse Creek (Mahoney 2006). Couse Creek has been impacted by grazing and agricultural land uses, resulting in a limited riparian corridor, channel down-cutting, erosion and high levels of streambed sedimentation (Volkman and Sexton 2003). Summer low flows are an issue on Couse Creek (Kuttel 2001); downstream portions of the stream are dry, leaving pools isolated (Volkman and Sexton 2003). The historical, synthesized flow record indicates Couse Creek can experience periods of zero flow during the months of July through October (Stetson Engineers 2012). Instream habitat is described as lacking channel diversity, having low pool frequency and exhibiting high temperatures (Volkman and Sexton 2003).

Steelhead juvenile rearing is a priority from June through January and adult migration and spawning are a priority from February through May (Table 11).

Prescriptive flows in Couse Creek are a result of applying hydrologic criteria (independent of priority species or life stage) using a modified Tennant Method, as described in Section 2.6.2 and Appendix D, Table D-3; the results are presented in Table 12.

In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1934–2011, the 2-year recurrence interval flow is 356 cfs and the 7-year recurrence interval flow is 918 cfs.

3.3.5 Reach 5

Reach 5 is a critical reach for upstream migration of adult Chinook, bull trout, and steelhead. In addition, juvenile steelhead, bull trout and spring Chinook rear year-round in Reach 5. Flows are severely compromised by irrigation, groundwater pumping and loss of flow to the groundwater system. There are reports dating back to 1880 of the river being dewatered from Milton Freewater to 6 miles downstream (Kuttel 2001). About 70% of the surface irrigation water in the Oregon portion of the Walla Walla River Basin is delivered by the WWRID and the HBDIC (Appendix F). The combined water rights for the two districts are approximately 280 cfs and the combined peak diversion rate is approximately 150 cfs in June (Appendix F).

Reach 5 is confined by a series of dikes and levees and the channel is highly altered. Vegetation is removed from the levees, leaving the reach unshaded (Kuttel 2001). The primary limiting factors in this reach are low minimum flows and high water temperatures that cause low habitat suitability, although there is some water quality impairment as well (Appendix B). The habitat of primary interest is juvenile salmon and steelhead rearing habitat during the late summer and early fall. Spring Chinook migration is a priority in May and June and steelhead migration and spawning is a priority March and April, respectively (Table 9). Steelhead juvenile rearing is a priority from July through February. The prescriptive flows in Reach 5 are based on empirical results from the PHABSIM study in this reach (Appendix D, Figures D-1 and D-2, Table D-4) , along with consideration of inflow from upstream sources that include Couse Creek (Table 12). The magnitude and duration of exceedance of water temperature thresholds (Appendix E, Figures E–5 and E–6) in this reach during the summer rearing and Chinook spawning periods are expected to decrease as a result of this flow prescription, compared to current conditions.

The CTUIR have documented the impairment of adult Chinook and bull trout migration above the Nursery Bridge Dam at flows lower than 150 cfs (Mahoney et al. 2009). It is unknown if the passage issues are due to high water temperatures or a physical barrier at the dam. Therefore, a migration flow ranging between approximately 150 and 300 cfs in Reach 5 during migration is recommended. Migration flows could be achieved by temporarily limiting diversions at the Little

Walla Walla and Eastside diversion facilities. The prescription in Table 12 reflects higher flows that facilitate migration and barrier passage during the migration period.

Currently a significant portion of mainstem Walla Walla River flow is diverted by the WWRID and HBDIC in the Little Walla Walla irrigation canal; however this water is retained in the river in the representative hydrology calculated for Reach 5. In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented Table 10. Based on gage data spanning 1934–2009, the 2-year recurrence interval flow is 1,151 cfs and the 7-year recurrence interval flow is 1,558 cfs.

3.3.6 Yellowhawk Creek

Yellowhawk Creek is currently a distributary of Mill Creek. Historically, Yellowhawk Creek and other small spring fed streams in the area served as flood storage and potentially as cool water refugia for salmonids in the summer. The Army Corps of Engineers operates a flood control project on Mill Creek at Bennington Lake, 5 miles upstream of downtown Walla Walla. The flood control project routes floodwater into Bennington Lake, instead of allowing water to flow down Mill Creek and its distributary channels, thereby reducing flood damage to the City of Walla Walla and surrounding areas. Mill Creek flows are diverted to Yellowhawk Creek by the U.S. Army Corps of Engineers at the Division Dam, and conveyed to irrigation projects, with any return flows entering Walla Walla River Reach 4.

Yellowhawk Creek flows in an incised and heavily eroded channel through areas of land use ranging from urban to semi-rural. Mendel et al. (2000) report the channel to be fairly deep and narrow. Yellowhawk Creek has infrequent pools of moderate to fair quality (Reckendorf and Tice, 2000). Stream banks on Yellowhawk Creek are reported to be unstable due to urban development and incising due to increased flows diverted from Mill Creek (Kuttel 2001). Streambed gravels are embedded due to lack of flushing flows (Kuttel 2001). Little to no floodplain connectivity prevents recruitment of large woody debris or development of off-channel habitat (Kuttel 2001). The riparian zone is limited to trees immediately adjacent to the stream banks. Beaver are present within the system (Kuttel 2001).

Yellowhawk Creek serves as a migratory route for adult steelhead, spring Chinook and bull trout between the mainstem Walla Walla River and upper Mill Creek (Mahoney et al. 2006, 2009, 2011), since lower Mill Creek is non-passable due to dry, low flow, and/or barrier conditions during the dry season. Yellowhawk Creek also serves as a migratory route for steelhead to access Cottonwood Creek. It is unclear to what degree fish passage is successful in Yellowhawk Creek due to various fish passage barriers, including the Division Dam. Steelhead kelts use Yellowhawk Creek for downstream migration (Mahoney et al. 2006). Steelhead spawn in Yellowhawk Creek (Mahoney et al. 2006 and 2011), however, the outcome of spawning is unknown. Cottonwood, Russell and Caldwell creeks, tributaries to Yellowhawk Creek, all provide steelhead rearing and presumed steelhead spawning (WWBWC 2004a); flow in Yellowhawk Creek provides access to these habitats. Juvenile steelhead have been found rearing in Yellowhawk Creek (Mendel et al. 2002, 2003, 2004). Chinook juveniles have not been found in Yellowhawk Creek to date.

Steelhead adult migration is a priority in February and March and spawning is a priority in April and May (Table 11).

Flow prescriptions in Yellowhawk Creek are based on applying a toe-width method (Section 2.6.3 and Appendix D, Table D-5), since neither PHABSIM nor sufficient historical flow data are available to use other methods. Using this method, prescriptive flows in Table 12 are derived mostly from the current channel configuration of Yellowhawk Creek, which has to a significant degree been influenced by the elevated flows provided through long-term diversion of water from Mill Creek. As a result, there is some risk that meeting Yellowhawk Creek prescriptive flow targets might require continued Mill Creek diversions that conflict with providing prescribed flows in the lower portions (below the Division Dam) of Mill Creek.

3.3.6.1 Cottonwood Creek

Cottonwood Creek is a tributary to Yellowhawk Creek and has a drainage area of approximately 28.8 square miles (Stetson Engineers 2012). Flow in the basin is derived mostly from rain and snowmelt. Base flows at the mouth approach 0 cfs during drier months, based upon synthesized data from Stetson Engineers (Appendix C), substantiated by reports that the creek goes dry during the irrigation season (Kuttel 2001). There are 8 diversions and 23 water rights in the Cottonwood Creek basin (EES 2005).The WDFW surveyed the lower basin from Braden Road to Hood Road in July 2000, July and August 2001 and June 2002 and found 0+ and1+ steelhead present each year. Radio-tagged adult steelhead have been tracked to Cottonwood Creek as their terminal destination (Mahoney 2006), and WDFW found a single redd in a one day survey of 4 miles of stream in both 2000 and 2001 (Mendel et al. 2007). The fish use of the headwaters of Cottonwood Creek is a data gap, although rearing habitat conditions in the upper watershed are reported to be marginal to good (EES 2005). The riparian zone is limited to a thin strip of trees on each bank or is absent. The main land use in the floodplain is dryland agriculture (Kuttel 2001). Portions of the channel are deeply incised due to removal of the riparian vegetation and other land use practices (Kuttel 2001). Temperature in lower Cottonwood Creek increases as flow decreases in mid-late May and baseflow conditions are established. A stream restoration project was undertaken near Powerline Road to reduce effects of channel straightening (B. Zimmerman, Biologist, CTUIR, pers. comm., June 27, 2012).

Steelhead are the priority species in Cottonwood Creek. Life stage priorities are rearing from June through January, migration from February through March, and spawning in April through May(Table 11).

Prescriptive flows in Cottonwood Creek are a result of applying hydrologic criteria using a modified Tennant Method, as described in Section 2.6.2 and Appendix D, Table D-3; the results are presented in Table 12.

Approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1934–2011, the 2-year recurrence interval flow is 582 cfs and the 7-year recurrence interval flow is 1,238 cfs.

3.3.7 Reach 4

This reach serves as a migration corridor for adult and juvenile life stages of all priority species, and as juvenile rearing habitat for low densities of the priority species (Kuttel 2001, Mendel et al. 2007). Reach 4 serves as a vital connection between lower Mill and Yellowhawk creeks during the irrigation season. The primary limiting factors in this reach are low minimum flows and high water temperatures that cause low habitat suitability, particularly for juvenile salmon and steelhead rearing during the late summer and early fall (Appendix B). Spring Chinook migration is a priority in May through June and steelhead adult migration is a priority in February through April. Steelhead juvenile rearing is a priority July through January (Table 11). These species and life stage priorities are reflected in the flow prescription presented in Table 12, which considers both the PHABSIM results from this reach (Appendix D, Figures D-3 and D-4, Table D-6) as well as the inflow from Cottonwood Creek.[2] The magnitude and duration of water temperature threshold exceedance (Appendix E, Figures E–3 and E–4) in this reach during the summer months are expected to decrease as a result of this flow prescription, compared to current conditions.

In addition to the minimum flow prescriptions presented in Table 12 approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1934–2009, the 2-year recurrence interval flow is 1,374 cfs and the 7-year recurrence interval flow is 1,905 cfs.

3.3.8 Reach 3

This reach of the Walla Walla River is used primarily as a migration corridor by priority species during the winter and spring (Walla Walla County and WWBWC 2004a, Kuttel 2001). Reach 3 supports low densities of juvenile rearing of all priority species (Mendel et al. 2007). It is expected that increased flow in Reach 3 will support rearing of all priority species. The Old Lowden and Garden City diversions are located in Reach 3 and combined remove up to 31 cfs from the river (Appendix F).

The primary limiting factors in this reach are low summer flow and high water temperature that cause low habitat suitability, although there is some water quality impairment as well (Appendix B). Spring Chinook migration is a priority in May through June and juvenile fry rearing is a priority July through October (Table 11). Steelhead migration is a priority November through April (Table 11). These priorities are reflected in the flow prescription presented in Table 12, which considers both the PHABSIM results from this reach (Appendix D, Figures D-5 and D-6, Table D-7) as well as the inflow from upstream reaches and Mill Creek. Although Reach 3 is not a spawning reach, the data indicate that these flows would provide reasonably high habitat value for spawning and rearing; this suggests that the flow prescription is likely suitable for both upstream and downstream migration as well. The duration and magnitude of exceedance of water temperature thresholds (Appendix E, Figures E–1 and E–2) in this reach during the summer months are expected to decrease as a result of this flow prescription, compared with current conditions.

The high flow dataset for Reach 3 builds off of the data from Reach 4 and flow contributions from Mill Creek; other small tributaries that flow into the Walla Walla River in this reach are not expected to consistently provide significant flow and are not included. In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1940–1971, the 2-year recurrence interval flow is 2,015 cfs and the 7-year recurrence interval flow is 3,571 cfs. These high flow values assume conservation of mass and neglect tributary inflows into the mainstem

[2] Yellowhawk Creek prescribed flows were not summed in the additive prescribed inflow to Walla Walla Reach 4 due to the influence of diversions, and channel degradation that could affect the toe-width calculations. PHABSIM results from Walla Walla Reach 4 were sufficient to ensure an adequate flow prescription in that reach, regardless of inflow.

Walla Walla downstream of Reach 6. Refer to Section 2.5.1.1 for a description of the hydrology dataset.

3.3.9 Dry Creek

Dry Creek is a tributary to the Walla Walla River, draining 242.8 square miles of land north of Mill Creek (Stetson Engineers 2012). Dry Creek receives less snowfall than other higher elevation subbasins in the Walla Walla River basin, and lack of winter storage results in high winter peak flows and low summer base flows that frequently drop to 1 cfs or less (Stetson Engineers 2012). Significant irrigation occurs in the Dry Creek subbasin; diversion quantities listed for water rights in the subbasin a total of 101.7 cfs and the irrigated area totals 3,090 acres (Stetson Engineers 2012). Lower Dry Creek is deeply incised with heavily eroding banks, limited floodplain connectivity, and a thin strip of riparian vegetation. Heavy erosion and subsequent downcutting in the lower basin account for highly embedded streambed material. Dry Creek carries a high sediment load, 252,000 tons per year (Kuttel 2001). Pool habitat quality and frequency is unknown (Kuttel 2001). Habitat quality including large woody debris frequency and off-channel habitat access in the lower basin is poor (Kuttel 2001). Late spring and early summer temperatures frequently exceed 75°F and likely create a migration barrier to steelhead below Talbott Road and below Dixie, WA (Mendel et al. 2007).

The upper Dry Creek watershed (several miles upstream of Dixie, WA) has a reasonably intact riparian zone, high pool frequency, fair pool quality, acceptable floodplain connectivity and low volumes of bank erosion; large woody debris is infrequent (Kuttel 2001). Steelhead are known to spawn in upper Dry and North Fork Dry creeks (Mahoney 2009); only wild steelhead were found in Dry Creek during a radio tag survey effort (Mahoney 2006, Mahoney 2009). WDFW found 0+ and 1+ age steelhead throughout middle and upper Dry and North Fork Dry creeks. Temperatures in upper Dry Creek exhibit a large diurnal fluctuation, and in the summer average 60–65 °F, with daily excursions over 70°F (Mendel et al. 2002, Mendel et al. 2003). Temperatures in North Fork Dry Creek were lower than the mainstem during the same time period.

Steelhead migration is a priority October through March. Spawning is a priority April and May and juvenile rearing is a priority June through September (Table 11). Prescriptive flows in Dry Creek are a result of applying hydrologic criteria using a modified Tennant Method, as described in Section 2.6.2 and Appendix D, Table D-3; the results are presented in Table 12.

Approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1949–1989, the 2-year recurrence interval flow is 1,094 cfs and the 7-year recurrence interval flow is 2,736 cfs.

3.3.10 Reach 2

This reach of the Walla Walla River is used primarily as a migration corridor by priority species during the winter and spring (Walla Walla County and WWBWC 2004a, Kuttel 2001). Although the river is confined by dikes and the channel length is reduced and simplified, channel condition was not considered a limiting factor (in the absence of migration barriers). Water temperature and low flow issues were primary concerns for migrating adult spring Chinook and bull trout; in past years high water temperatures have created a migration barrier in the reach. No evidence of limiting water quality conditions during periods of upstream adult migration was noted in the literature.

Steelhead migration is a priority October through April, and spring Chinook migration is a priority May through June; flow prescriptions for July through September are based upon continuity of flow prescribed in Reach 3 for juvenile steelhead (Table 11). Continuity of upstream flows prescribed in Reach 3 for migration (November through June) and summer rearing drive the flow prescriptions in this reach (Table 12).

Levees in the lower reaches constrain the flow and likely affect the hydrologic connectivity of the channel and floodplain. Approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1949–1971, the 2-year recurrence interval flow is 2,205 cfs and the 7-year recurrence interval flow is 3,571 cfs. These flow prescriptions build off of the data from upstream reaches.

3.3.10.1 Pine Creek

Pine Creek is a tributary to the Walla Walla River and connects to the lower portion of Walla Walla Reach 2. Pine Creek drains 167.7 square miles of lower elevation Palouse hills and receives less snowfall than surrounding subbasins in the Walla Walla River (Stetson Engineers 2012). As a result of low winter storage, Pine Creek responds quickly to precipitation with high winter peaks and also exhibits low base flows that approach 0 cfs annually (Stetson Engineers 2012). Pine Creek and its main tributary, Dry Creek (OR), are heavily impacted by irrigation (Stetson Engineers 2012). Pine Creek is deeply incised and has no riparian buffer as a result of land clearing and agricultural activity (Kuttel 2001). Little to no aquatic habitat data exists for Pine Creek; however Kuttel (2001) assumes that due to channel incision and a lack of riparian zone in the Washington State portion of the subbasin, there is limited floodplain connectivity, limited off-channel habitat, high streambed embeddedness, a lack of large woody debris and high pool frequency. High temperatures may create a thermal migration barrier to migrating steelhead (Coyle et al. 2001, Mendel et al. 2003, Mendel et al. 2004). Electrofishing surveys in the forested upper watershed above RM 24 found 0+ and 1+ age class rainbow trout/steelhead in 2004 and 2005 (Mahoney et al. 2006). One pit-tagged adult steelhead was found in upper Pine Creek in a two-year study (Mahoney et al. 2006).

Steelhead migration is the priority in this reach in October through March, spawning is a priority April and May, and juvenile rearing is a priority July through September (Table 11). Prescriptive flows in Pine Creek are a result of applying hydrologic criteria using a modified Tennant Method, as described in Section 2.6.2 and Appendix D, Table D-3; the results are presented in Table 12.

In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1952–1989, the 2-year recurrence interval flow is 1,234 cfs and the 7-year recurrence interval flow is 3,486 cfs.

3.3.11 Reach 1

As with Reach 2, Reach 1 of the Walla Walla River is used primarily as a migration corridor by the priority species during the winter and spring (Walla Walla County and WWBWC 2004a, Kuttel 2001). Although the river is confined by dikes and the channel length is reduced and simplified, channel condition was not considered a limiting factor (in the absence of migration barriers). Water temperature and reduced stream flow issues were a primary concern for migrating adult spring Chinook and bull trout; in past years, low flow and high temperatures created a migration barrier. No evidence of limiting water quality conditions was noted in the literature.

Steelhead migration is a priority October through April, and spring Chinook migration is a priority May through June (Table 11). Continuity of upstream flows prescribed in Reaches 2 and 3 (which were derived from a combination of PHABSIM results, inflows to the reach, and water availability as estimated from exceedance flows) for migration (November through June) and during the summer period drive the flow prescriptions in this reach (Table 12).

In addition to the minimum flow prescriptions presented in Table 12, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1952–1968, the 2-year recurrence interval flow is 3,883 cfs and the 7-year recurrence interval flow is 6,706 cfs. These flow prescriptions build off of the data from upstream reaches (Reach 2), and include flow from Pine Creek and Touchet River.

3.3.12 Walla Walla basin summary

A summary of flow prescriptions for the Walla Walla basin is presented Table 13 and Figures 4 and 5.

Table 13. Summary of flow prescriptions for the Walla Walla River basin.

Reach	Minimum flow (cfs) by month											
	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
South Fork Walla Walla (SFWW)	70	70	70	70	74	85	111	122	82	70	70	70
North Fork Walla Walla (NFWW)	11	21	21	27	30	38	52	43	21	11	6	7
Walla Walla River Reach 6 (WWR6) (Below North Fork/South Fork confluence)	90	91	91	97	104	180	281	218	151	81	76	77
Couse Creek	1	5	6	7	9	11	16	12	5	1	0.3	0.3
Walla Walla River Reach 5 (WWR5) (Below Milton Freewater)	91	96	97	105	112	197	297	230	156	90	90	90
Cottonwood Creek	1	9	9	12	15	18	25	17	9	1	0	0
Yellowhawk Creek	21	15	15	18	45	45	42	38	15	18	9	15
Walla Walla River Reach 4 (WWR4) (Below Yellowhawk Creek)	92	105	106	117	127	215	322	247	165	91	90	90
Walla Walla River Reach 3 (WWR3) (Below Mill Creek)	138	160	170	191	215	319	471	357	237	143	135	135
Dry Creek	4	9	11	17	19	19	17	10	9	3	2	2
Walla Walla River Reach 2 (WWR2) (Below Dry Creek)	142	169	180	208	235	338	488	367	246	146	137	137
Pine Creek	1	4	6	10	11	11	11	5	3	0	0	0
Walla Walla River Reach 1 (WWR1) (Below Touchet River)	190	237	268	320	398	561	735	529	313	183	163	170

[1] Or natural inflow, whichever is less.

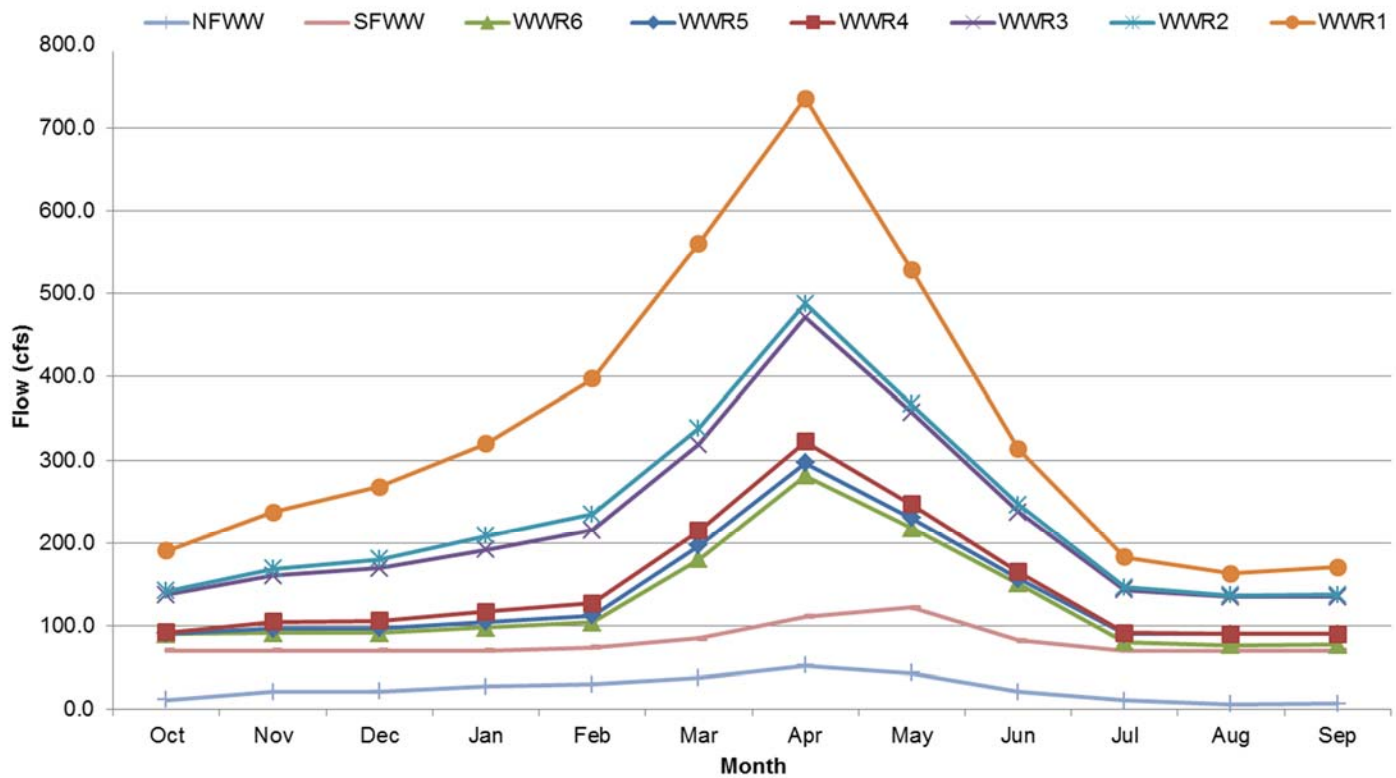

Figure 5. Walla Walla River flow prescriptions.

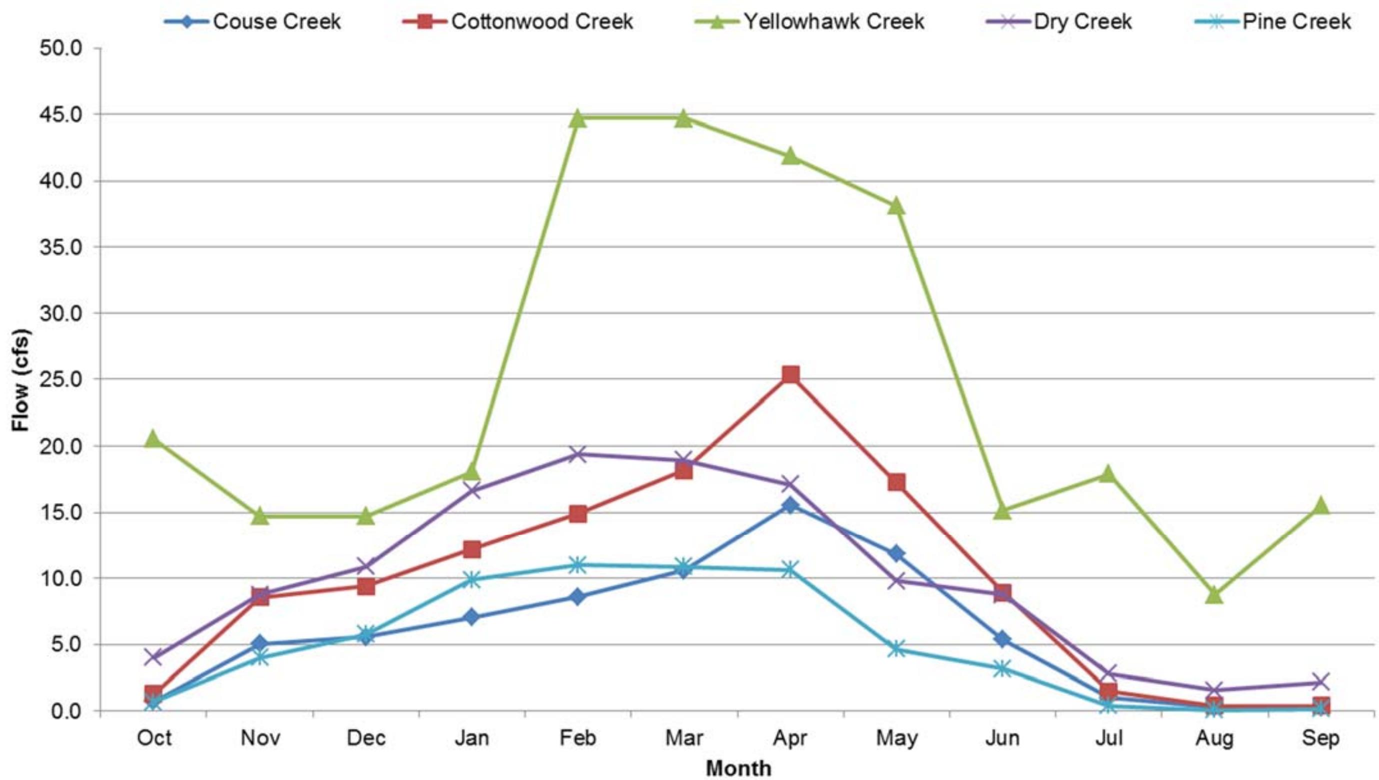

Figure 6. Walla Walla River tributaries flow prescriptions.

3.4 Mill Creek

3.4.1 Reach 5

The upper portion of Mill Creek Reach 5 is closed to public access to protect the quality of the City Walla Walla municipal water supply (Kuttel 2001). The habitat, water quantity and temperature of the stream system are fairly intact for supporting salmon and trout. This uppermost reach of Mill Creek supports significant spawning and rearing habitat for all three priority salmonid species. Steelhead rearing is a priority from October through January (Table 11). Steelhead adult migration is a priority in February and March. Steelhead spawning is a priority in April. Spring Chinook migration is a priority from May through June and spawning is a priority life stage in August and September. Available data do not suggest that conditions other than low flow are limiting factors to priority species productivity. Since Reach 5 is contiguous with downstream Reach 4, shares similar species and life stage priorities, and is expected to have similar habitat and flow relationships to Reach 4 (where a PHABSIM model was produced), the flow prescription for Reach 5 uses PHABSIM results from Reach 4 (Table 14). PHABSIM data are presented in Appendix D, Figures D-7 and D-8, Table D-8. The flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less.

Based on gage data spanning 1940–1971, the 2-year recurrence interval flow is 630 cfs and the 7-year recurrence interval flow is 995 cfs (Table 10).

Table 14. Prescriptive flows for the Mill Creek basin.

Reach	Metric	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
Mill Creek Reach 5—MC5	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Spawning	CH Adult migration	CH Adult migration	CH Adult migration	CH Spawning	CH Spawning
	MC4 80%WUA-ascending	85.2	85.2	85.2	85.2	75	75	75	61	61	61	61	61
	MC4 100%WUA peak	200	200	200	200	150	150	150	100	100	100	100	100
	MC4 80%WUA-descending	200	200	200	200	200	200	200	200	200	200	200	200
	Preliminary Target Flow	85.2	85.2	85.2	85.2	75	200	200	200	200	61	61	61
	MC4 80% Exceedance Flow	43	49	55	62	76	90	131	104	66	51	44	44
	Prescribed Flow	**43**	**49**	**55**	**62**	**75**	**90**	**131**	**104**	**66**	**51**	**44**	**44**
Mill Creek Reach 4—MC4	Additive Prescribed Inflow	43	49	55	62	75	90	131	104	66	51	44	44
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Spawning	CH Adult migration	CH Adult migration	CH Adult migration	CH Spawning	CH Spawning
	80%WUA-ascending	85.2	85.2	85.2	85.2	75	75	75	61	61	61	61	61
	100%WUA peak	200	200	200	200	150	150	150	100	100	100	100	100
	80%WUA-descending	200	200	200	200	200	200	200	200	200	200	200	200
	Preliminary Target Flow	85.2	85.2	85.2	85.2	75	200	200	200	200	61	61	61
	MC4 80% Exceedance Flow	43	49	55	62	76	90	131	104	66	51	44	44
	Prescribed Flow	**43**	**49**	**55**	**62**	**75**	**90**	**131**	**104**	**66**	**51**	**44**	**44**
Blue Creek	Modified Tennant	3	6	9	12	13	13	13	6	6	1	1	1
Mill Creek Reach 3—MC3	Additive Prescribed Inflow	45.6	55.2	63.5	74.5	88.3	103.5	143.5	110.2	72.2	52.4	44.8	45.1
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	MC4 80%WUA-ascending	85.2	85.2	85.2	85.2	75	75	75	61	61	85.2	85.2	85.2
	MC4 100%WUA peak	200	200	200	200	150	150	150	100	100	200	200	200
	MC4 80%WUA-descending	200	200	200	200	200	200	200	200	200	200	200	200
	Preliminary Target Flow	85	85	85	85	88	200	200	200	200	85	85	85
	MC3 80% Exceedance Flow	44	51	58	68	87	104	149	110	67	51	45	45
	Prescribed Flow	**46**	**55**	**64**	**74**	**88**	**104**	**149**	**110**	**72**	**52**	**45**	**45**

Reach	Metric	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
Mill Creek Reach 2—MC2	Additive Prescribed Inflow	46	55	64	74	88	104	149	110	72	52	45	45
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	Flow continuation	Flow continuation	Flow continuation
	MC1 80%WUA-ascending	20	20	20	20	38	38	38	36	36	20	20	20
	MC1 100%WUA peak	40	40	40	40	60	60	60	56	56	40	40	40
	MC1 80%WUA-descending	130	130	130	130	100	100	100	80	80	130	130	130
	Preliminary Target Flow	46	55	64	74	88	104	149	110	80	52	45	45
	MC2 80% Exceedance Flow	44	51	58	68	87	104	149	110	67	51	45	45
	Prescribed Flow	**46**	**55**	**64**	**74**	**88**	**104**	**149**	**110**	**72**	**52**	**45**	**45**
Mill Creek Reach 1—MC1	WUA / Additive Prescribed Inflow	46	55	64	74	88	104	149	110	72	52	45	45
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	CH Adult migration	CH Adult migration	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	80%WUA-ascending	20	20	20	20	38	38	38	36	36	20	20	20
	100%WUA peak	40	40	40	40	60	60	60	56	56	40	40	40
	80%WUA-descending	130	130	130	130	100	100	100	80	80	130	130	130
	Preliminary Target Flow	46	55	64	74	88	104	149	110	80	52	45	45
	MC1 80% Exceedance Flow	44	51	58	68	87	104	149	110	67	51	45	45
	Prescribed Flow	**46**	**55**	**64**	**74**	**88**	**104**	**149**	**110**	**72**	**52**	**45**	**45**

[1] Or natural inflow, whichever is less.

3.4.2 Reach 4

Reach 4 provides habitat for Chinook salmon, bull trout, and steelhead. Chinook salmon in the basin are mainly outplanted by the CTUIR. This reach of Mill Creek begins to support more significant amounts of spawning habitat for salmon and steelhead, and rearing for all three priority species. Steelhead rearing is a priority from October through January (Table 11). Steelhead adult migration is a priority in February and March. Steelhead spawning is a priority in April. Spring Chinook migration is a priority from May through June and spawning is a priority life stage in August and September. Available data do not suggest that conditions other than minimum flow are limiting salmonid productivity in this reach (Appendix B). During non-spawning periods, the flow priority was placed on juvenile rearing for steelhead and Chinook salmon; although the habitat flow relationships for juveniles of the two species are different in this reach, the prescribed flow provides a balance between them, reflects inflection points in the WUA versus flow curves, and would largely maintain the habitat conditions present during the late summer spring Chinook spawning and incubation period. The flow prescription presented in Table 14 reflects these priorities, and is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less. PHABSIM data are presented in Appendix D, Figures D-7 and D-8, Table D-8.

Estimates of flow in Reach 4 suggest that even ‘historical’ runoff in July through November may be inadequate to achieve the desired habitat values in these months (Table 9). As a result, the flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less.

In addition to the minimum flow prescriptions presented in Table 14, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1940–1971, the 2-year recurrence interval flow is 630 cfs and the 7-year recurrence interval flow is 995 cfs.

3.4.3 Blue Creek

Blue Creek is a tributary of Mill Creek and drains 19.7 square miles of the Blue Mountains. Flows are high in winter and spring months (December through May) and low from June through October or November. Base flows in lower Blue Creek decrease to $\leq$ 1 cfs on an annual basis as measured by USGS gaging station 14013500 located about 0.9 miles upstream from its confluence with Mill Creek. Blue Creek provides habitat for steelhead spawning, rearing, overwintering and migration (Mendel et al. 2007). Blue Creek is considered to have streambed sedimentation (embeddedness) issues caused by land use (Kuttel 2001) and the 1996 flood (EES 2005). Riparian cover, pool frequency and large woody debris frequency are characterized as poor (Volkman and Sexton 2003, EES 2005). The CTUIR planted riparian trees to address environmental factors in the Blue Creek basin (Volkman and Sexton 2003). Rural home development pressure is increasing in the Blue Creek watershed (J. Volkman, CTUIR, pers. comm., January 10, 2011).

Prescriptive flows in Blue Creek are a result of applying hydrologic criteria using a modified Tennant Method, as described in Section 2.6.2 and Appendix D, Table D-3; the results are presented in Table 14. The flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less.

Based on gage data from Blue Creek, the 2-year recurrence interval flow is 494 cfs and the 7-year recurrence interval flow is 1,023 cfs (Table 10).

3.4.4 Reach 3

Reach 3 is located directly upstream of Bennington Dam (Figure 2). The reach experiences high temperatures and low flows in the spring and summer (Mendel et al. 2007). This reach of Mill Creek is the lowermost reach providing some steelhead spawning, as well as rearing habitat for Chinook and steelhead (Kuttel 2001). Steelhead juvenile rearing is a priority from July through January, steelhead adult migration is a priority from February through April and spring Chinook migration is a priority in May and June (Table 11).The results of the PHABSIM analysis for Reach 4 upstream were used for prescribing flows in this reach, due to similarities in the priority species and life stages, habitat use, and the availability of data in this portion of Mill Creek. The prescribed flows in Table 14 reflect a variety of species and life stage priorities depending on the time of the year, and are largely driven by flow availability (reflected in exceedance flow values) rather than PHABSIM results. The flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less.

In addition to the minimum flow prescriptions presented in Table 14, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data, the 2-year recurrence interval flow is 801 cfs and the 7-year recurrence interval flow is 1,170 cfs.

3.4.5 Reach 2

Reach 2 is a highly altered cement channel that runs through and underneath the City of Walla Walla. Since much of the channel is no longer natural, typical habitat assessment methodologies such as PHABSIM are of little use, and such data do not exist for this reach. There are currently studies under way to reconstruct portions of the channel to allow fish passage at a range of flows. Given the changing nature of Reach 2, the priority for this reach is currently to facilitate migration through the area (Appendix B) and connectivity between more suitable rearing or spawning areas upstream and/or downstream. In order to provide flow continuity from upstream areas in Reach 2, and have sufficient flow for downstream reaches, the flow prescription for Reach 2 maintains the prescribed flow from Reach 3 upstream (Table 14). Priority species were not identified for July, August and September due to the lack of habitat in Reach 2. The flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less.

Higher overbank and channel maintenance flows are not prescribed for Reach 2 because the reinforced levees that contain floods preclude any ecological benefits the high flows are intended to provide.

3.4.6 Reach 1

This reach of Mill Creek supports juvenile salmonid rearing and serves as a migration corridor. Steelhead juvenile rearing is a priority from July through January, steelhead adult migration is a priority from February through April and spring Chinook migration is a priority in May and June (Table 11).During irrigation season, most anadromous fish migration to the upper reaches of Mill Creek is through Yellowhawk Creek. The primary limiting factors in this reach are low minimum flows and high water temperatures that cause low habitat suitability (Appendix B). These factors affect juvenile rearing, as well migration through this reach by juveniles and adults. The

PHABSIM data from this reach suggest that lower minimum flows are required to optimize habitat than are indicated for Reach 3 upstream, which is an atypical pattern. This is substantively due to channel changes that have occurred due to upstream flood control and water diversion activities, which have altered the flow-habitat relationship in the downstream reaches. In this reach, flow prescription Rule #5 regarding flow continuity ends up superseding any prescription tied directly to the PHABSIM results (Appendix D, Figures D-9 and D-10, Table D-9), and prescribed upstream flows are carried through Reach 1 (Table 14). The flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural flow, whichever is less. The duration and magnitude of exceedance of water temperature thresholds in this reach during the summer months are expected to decrease as a result of this flow prescription, compared to current conditions.

In addition to the minimum flow prescriptions presented in Table 14, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data from Mill Creek, the 2-year recurrence interval flow is 801 cfs and the 7-year recurrence interval flow is 1,170 cfs.

3.4.7 Mill Creek basin summary

A summary of flow prescriptions for the Mill Creek basin is presented in Figure 7 and Table 15.

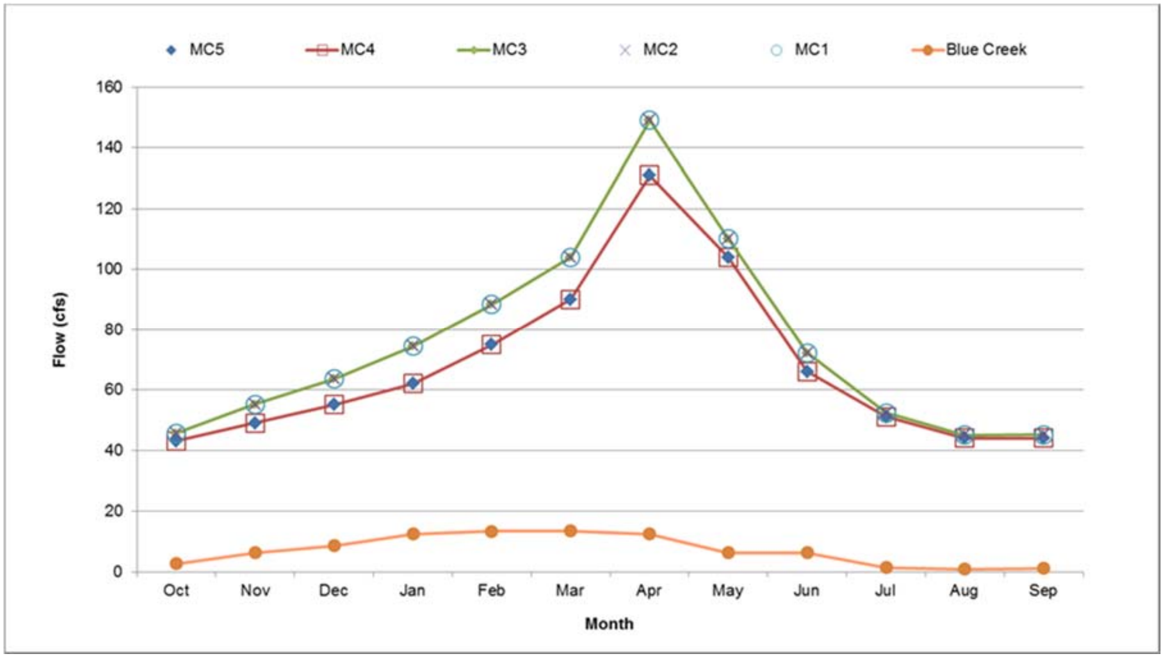

Figure 7. Mill Creek basin flow prescriptions.

Table 15. Summary of flow prescriptions for the Mill Creek basin.

Reach	Minimum flow (cfs) by month											
	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
Mill Creek Reach 5 (Above WW Diversion)	43	49	55	62	75	90	131	104	66	51	44	44
Mill Creek Reach 4 (Below WW Diversion)	43	49	55	62	75	90	131	104	66	51	44	44
Blue Creek	3	6	9	12	13	13	13	6	6	1	1	1
Mill Creek Reach 3 (Below Blue Creek)	46	55	64	74	88	104	149	110	72	52	45	45
Mill Creek Reach 2 (Below Bennington)	46	55	64	74	88	104	149	110	72	52	45	45
Mill Creek Reach 1 (Below City of Walla Walla)[4]	46	55	64	74	88	104	149	110	72	52	45	45

[1] Or natural inflow, whichever is less.

3.5 Touchet River

3.5.1 South Fork Touchet River

The South Fork Touchet River is primarily a juvenile rearing and spawning reach for steelhead, with productivity limited by high summer water temperatures, low minimum flows, and degraded channel conditions that cause low habitat suitability (Appendix B). Steelhead rearing is the priority life stage from July through January (Table 11). Adult migration upstream to spawning grounds is prioritized in February and March, and downstream migration prioritized in June. Flows were prescribed for spawning in April and May. There was no previous instream flow study in this river, but suitable flows were estimated using the modified Tennant method (Appendix D, Table D-3) based on comparative hydrology data from the nearby Dry Creek basin (which had better hydrologic records). Like other tributary streams/reaches to the mainstem Touchet River, even 'representative' flows may not be sufficient to achieve the prescribed flow in some months, and the flow prescription (Table 16) includes a condition of "or natural inflow, whichever is less" to acknowledge this fact. The magnitude and duration of exceedance of water temperature thresholds in this reach during the summer rearing period are expected to decrease as a result of this flow prescription, compared to current conditions.

Channel condition was also considered a limiting factor in the South Fork Touchet River, and water quality does not meet TMDL standards. Although there are no data suggesting water quality is a limiting factor for priority species in the South Fork, it is uncertain whether channel conditions would prevent significantly greater rearing or spawning habitat even under a more favorable flow and temperature regime.

Hydrologic data are so sparse for the South Fork Touchet River that prescriptions for channel maintenance and riparian zone health were not developed.

Table 16. Prescriptive flows for the Touchet River basin.

Reach	Metric	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
North Fork Touchet River—NFT	Priority Species & Life Stage	BT Spawning	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Spawning	SH Spawning	BT Adult migration / holding	BT Adult migration / holding	BT Adult migration / holding	BT Spawning
	80%WUA-ascending	25	58	58	58	89	89	89	89	81	81	81	25
	100%WUA peak	60	100	100	100	125	125	125	125	122	122	122	60
	80%WUA-descending	200	250	250	250	195	195	195	195	197	197	197	200
	Preliminary Target Flow	25	58	58	58	89	195	195	195	197	81	81	25
	80% Exceedance Flow	42	46	61	55	88	102	140	124	63	43	40	40
	Prescribed Flow	**25**	**46**	**58**	**55**	**88**	**102**	**140**	**124**	**63**	**43**	**40**	**25**
South Fork Touchet River—SFT	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Spawning	SH Spawning	SH Adult migration	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	Modified Tennant	3	6	6	7	12	13	14	7	6	2	1	2
	80% Exceedance Flow	2	3	5	7	14	19	21	9	3	1	1	1
	Prescribed Flow	**2**	**3**	**5**	**7**	**12**	**13**	**14**	**7**	**3**	**1**	**1**	**1**
Touchet River Reach 2—TRR2	Additive Prescribed Inflow	27	49	63	62	100	115	154	131	66	44	41	26
	Losing Reach Adjustment	0	0	0	0	0	0	0	0	-6	-9	-16	-9
	Net Prescribed Inflow Through Reach	27	49	63	62	100	115	154	131	60	35	25	17
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	80%WUA-ascending	103	103	103	103	140	140	140	140	103	103	103	103
	100%WUA peak	200	200	200	200	225	225	225	225	200	200	200	200
	80%WUA-descending	300	300	300	300	300	300	300	300	300	300	300	300
	Preliminary Target Flow	103	103	103	103	140	300	300	300	300	103	103	103
	80% Exceedance Flow	45	60	78	96	153	196	219	148	60	35	25	32
	Prescribed Flow	**45**	**60**	**78**	**96**	**140**	**196**	**219**	**148**	**60**	**35**	**25**	**32**
Coppei Creek—CC	Modified Tennant	4	7	7	14	14	16	16	7	7	1	0	1
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult spawning	SH Adult spawning	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing
	80%WUA-ascending	27	27	27	27	27	44	44	44	27	27	27	27
	100%WUA peak	62	62	62	62	62	62	62	62	62	62	62	62
	80%WUA-descending	100	100	100	100	100	100	100	100	100	100	100	100
	Preliminary Target Flow	27	27	27	27	27	44	44	44	27	27	27	27
	80% Exceedance Flow	2	3	4	6	12	16	17	8	3	1	1	1
	Prescribed Flow	**2**	**3**	**4**	**6**	**12**	**16**	**17**	**8**	**3**	**1**	**1**	**1**

Reach	Metric	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
Touchet River Reach 1—TRR1	Additive Prescribed Inflow	47	63	82	102	152	212	236	156	63	36	26	33
	Priority Species & Life Stage	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Juvenile/Fry rearing	SH Adult migration	SH Adult migration	SH Adult migration	SH Adult migration	BT Adult migration	Flow Continuation	Flow Continuation	Flow Continuation
	TRR2 80%WUA-ascending	103	103	103	103	140	140	140	140	130	103	103	103
	TRR2 100%WUA peak	200	200	200	200	225	225	225	225	225	200	200	200
	TRR2 80%WUA-descending	300	300	300	300	300	300	300	300	300	300	300	300
	Preliminary Target Flow	103	103	103	103	152	300	300	300	300	103	103	103
	TRR1 80% Exceedance Flow	48	64	82	102	165	210	236	157	64	36	26	33
	Prescribed Flow	**48**	**64**	**82**	**102**	**152**	**212**	**236**	**157**	**64**	**36**	**26**	**33**

[1] Or natural inflow, whichever is less.

3.5.2 North Fork Touchet River

The North Fork Touchet River supports all three priority species. Bull trout migration is prioritized from June through August, and spawning in September and October. Steelhead juvenile rearing is the priority life stage from November through January, adult steelhead migration is prioritized February and March and spawning is prioritized in April and May (Table 11). Numerous factors limit salmonid productivity in this reach, including minimum flow, summer water temperatures, and channel condition (Appendix B and Appendix E, Figures E-18 through E-21). Using the instream flow analysis of the North Fork Touchet River (Barber et al. 2001), prescriptive flows presented in Table 16 are driven by a combination of instream flow results and hydrologic constraints (i.e., 80% exceedance flows), depending on the month. PHABSIM results for North Fork Touchet River are presented in Appendix D, Figures D-11 and D-12, Table D-10. Like prescriptions in other upper Touchet River Basin streams, the minimum flow is conditioned for an option of lower flows during drier months of the year, when even full 'representative' flows may not be sufficient to achieve the prescribed threshold.

In addition to the minimum flow prescriptions presented in Table 16, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data the 2-year recurrence interval flow is 700 cfs and the 7-year recurrence interval flow is 1,300 cfs.

3.5.3 Reach 2

Reach 2 of the Touchet River, below the North/South Fork confluence and above Coppei Creek, is primarily a juvenile rearing reach for steelhead and salmon, although Chinook salmon spawning has recently been reported (Mahoney et al. 2011). Flows are prescribed for steelhead juveniles from July through January (Table 11). Steelhead adult migration is the priority from February through May. The primary limiting factors in this reach are high water temperatures and low minimum flows that cause low habitat suitability (Appendix B). The instream flow study in this reach (Barber et al. 2001) documented habitat/flow relationships for several species and life stages, although use of the reach by all of these life stages is not common. Threshold WUA values appear to be high relative to 'representative' flows in this reach, possibly due to degraded channel conditions, large seasonal variation in flows, or other factors. In addition, this is a typically a "losing" reach in the summer, having lower flows at the downstream end than the upstream end, even under historical conditions. As a result, the prescribed flows (Table 16) are adjusted to reflect the typical loss of flow in this reach, and Rule #5 regarding continuity of flow volume from upstream reaches was not applied.

PHABSIM results for Touchet River Reach 2 are presented in Appendix D, Figures D-13 and D-14, Table D-11.

Estimates of flow in Reach 2 suggest that even full 'representative' runoff in July–November may be inadequate to achieve the desired habitat values in these months (Table 9). As a result, the flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural 'historical' flow, whichever is less.

In addition to the minimum flow prescriptions presented in Table 16, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data, the 2-year recurrence interval flow is 1,591 cfs and the 7-year recurrence interval flow is 2,636 cfs.

3.5.4 Coppei Creek

Coppei Creek is primarily a juvenile rearing and spawning reach for steelhead, with productivity limited by high summer water temperatures and low minimum flows that cause low habitat suitability (Appendix B). Juvenile steelhead are the priority life stage from June through February, adult migration is the priority in March and steelhead spawning is prioritized in April and May. The instream flow study in this reach (Barber et al. 2003) documents habitat/flow relationships for steelhead; other salmonid species are rare or non-existent in this stream. Higher flows during the spring (e.g., ~40 cfs) may be beneficial to improve conditions for steelhead spawning, but the hydrologic data suggest that flows infrequently reach this level even during months of presumably little or no diversion (Table 9).

All of the PHABSIM-based results supported flows greatly in excess of even natural conditions, suggesting that the channel configuration may have degraded such that more flow is necessary to create desirable habitat, or perhaps the applied HSC were not as well-suited to a stream of this size. This situation is reflected in the flow prescription presented in Table 16, where the prescription defaults to hydrologic constraints (80% exceedance flow) in all months.

The magnitude and duration of exceedance of water temperature thresholds (Appendix E, Figure E–22 through E–23) in this reach during the summer rearing period may decrease as a result of this flow prescription, compared to current conditions.

Estimates of flow (based on limited, impaired flow gage records) in Coppei Creek suggest that even full ‘representative’ runoff in May–December may be inadequate to achieve the desired habitat values in these months (Table 9). As a result, the flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural inflow, whichever is less. PHABSIM results for Coppei Creek are presented in Appendix D, Figure D-15, and Table D-12.

Channel condition was not considered a limiting factor (in the absence of migration barriers), unless it might significantly affect habitat benefits provided at low flows. Although water quality does not meet TMDL standards, there are no data suggesting water quality is a limiting factor for priority species in Coppei Creek.

Bankfull and overbank flows for channel maintenance and riparian zone health, respectively, are prescribed in Table 10. The 2-year recurrence interval flow is 176 cfs and the 7-year recurrence interval flow is 314 cfs.

3.5.5 Reach 1

This reach of the Touchet River is used primarily as a migration corridor during the winter and spring (Kuttel 2001, Walla Walla County and WWBWC 2004b). Steelhead juvenile rearing is the priority life stage from October through January, followed by steelhead adult migration from February through May and bull trout adult migration in June (Table 11). No priority life stage was identified from July through September due to low flow and high water temperatures, and flows in these months were prescribed to simply continue the inflow from Reach 2 upstream.

The flow prescriptions for this reach (Table 16) are primarily driven by flow availability and continuity from the upstream reaches (Touchet River Reach 2 and Coppei Creek), since there is typically insufficient flow to achieve PHABSIM-based targets (which are based on surrogate targets from the PHABSIM study in Reach 2), and site-specific data on wetted area are not available. As with upstream reaches, the flow prescription is conditioned for July–November to reflect an option for the prescribed flow or natural 'historical' flow, whichever is less.

The channel condition is poor in this reach due to high levels of erosion and embeddedness and a lack of an intact riparian zone (Kuttel 2001). Since the reach does not support a variety of priority species life stages, channel condition was not considered a limiting factor (in the absence of migration barriers), and although water quality does not meet TMDL standards, there are no data suggesting water quality is a limiting factor for fish. Water temperatures during the winter and spring migration periods were of lower concern than in the primary rearing and spawning areas upstream (See Appendix E, Figures E–12 through E–14). Habitat conditions in Reach 1 are poor; there is an overall lack of pools, large woody debris, and cover (Kuttel 2001).

In addition to the minimum flow prescriptions presented in Table 16, approximate bankfull (2-year) and overbank (7-year) recurrence interval flow prescriptions for channel maintenance and riparian zone health, respectively, are presented in Table 10. Based on gage data spanning 1952–1989, the 2-year recurrence interval flow is 1,780 cfs and the 7-year recurrence interval flow is 2,850 cfs.

3.5.6 Touchet River basin summary

A summary of flow prescriptions for the Touchet River basin is presented in Figure 8 and Table 17.

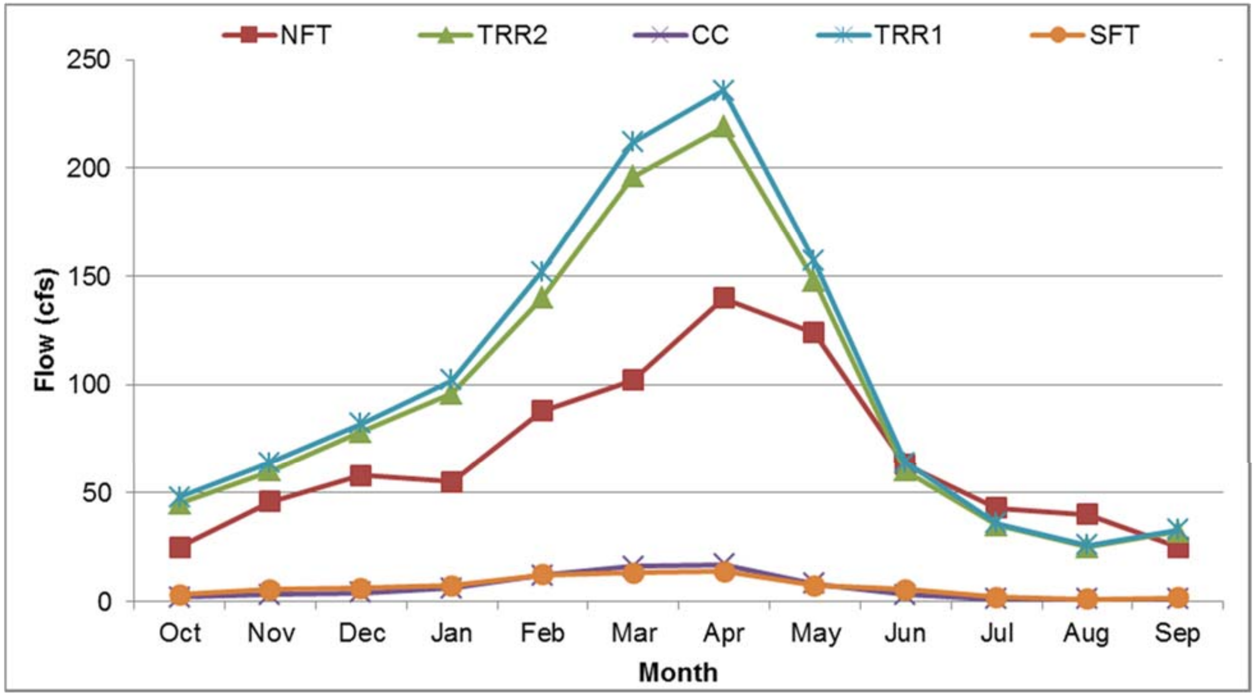

Figure 8. Touchet River basin flow prescriptions.

Table 17. Summary of flow prescriptions for the Touchet River basin.

Reach	Minimum flow (cfs) by month											
	Oct[1]	Nov[1]	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul[1]	Aug[1]	Sep[1]
North Fork Touchet (NFT)	25	46	58	55	88	102	140	124	63	43	40	25
South Fork Touchet (SFT)	2	3	5	7	12	13	14	7	3	1	1	1
Touchet River Reach 2(TRR2) (Below North Fork/South Fork Confluence)	45	60	78	96	140	196	219	148	60	35	25	32
Coppei Creek (CC)	2	3	4	6	12	16	17	8	3	1	1	1
Touchet River Reach 1 (TRR1) (Below Coppei Creek)	48	64	82	102	152	212	236	157	64	36	26	33

[1] Or natural inflow, whichever is less.

4 DISCUSSION

4.1 General Conclusions

The hydrologic regime of the Walla Walla Basin is highly altered by irrigation projects and land use and agricultural practices. Confinement by levees and dikes reduces the natural geomorphic and ecological processes of the river. Long reaches of the Walla Walla River, Touchet River, and Mill Creek are not used by multiple life stages of priority species due to altered hydrology, reduced habitat function, and high water temperature. These factors can result in inadequate quantity or quality of physical habitat (e.g., wetted area with the proper depth, velocity, substrate, and/or cover to support critical life stages of the priority species), decreased food production or protection from predation, or thermal stresses that compromise or preclude survival.

The flow regime in these river basins is the primary determinant of their suitability to support the priority species, as it significantly affects channel condition, habitat quantity and quality, and thermal conditions. The flow prescriptions provided in Section 3 are designed to provide a minimum flow, as well as channel and riparian zone maintenance flows that will protect and optimize conditions for life stages of the priority species, thereby helping ensure their continued availability as First Foods for the CTUIR.

The available hydrology data for the Walla Walla Basin are discontinuous and represent an altered hydrologic regime. Irrigation and municipal withdrawals from the groundwater and surface water sources in the Walla Walla Basin diminish flow necessary to provide adequate habitat for aquatic species, but the magnitude of the effect cannot be precisely quantified due to data limitations in gaging records (and the very long history of water withdrawals). However, the primary uses of the hydrologic data in this analysis were to: 1) determine the approximate frequency, duration, and magnitude of high flow events, which are less affected by water diversion because of their relative size and the typical season of their occurrence, and 2) provide a “reality check” that estimated accretion volumes and prescribed minimum flows would in fact be available in the specified reaches under a historical flow regime. Thus, the minimum instream flow prescriptions in Tables 13, 15, and 17are unaffected by the limitations of the hydrologic record. The flow prescriptions are substantively based upon WUA–flow relationships (which rely upon hydraulic conditions, channel characteristics, and biological data) and continuity of upstream flow prescriptions, not on hydrology. Representative hydrology is relevant, however, to help ascertain if prescribed flows are reasonably achievable, and mean flow data presented in Table 9 were evaluated with that objective.

Development and adoption of instream flow prescriptions is a complicated process that typically involves many stakeholders, and conflicting demands on a limited resource. Flow prescriptions presented in Section 3 do not attempt to balance all possible water uses. However, by prescribing *minimum* flows there is inherent recognition that flows above this level may be even more beneficial, but will present increased conflict with other water uses and more difficult trade-offs between various beneficial uses. In fact, the prescriptions recognize that in some reaches an optimum flow cannot be achieved because there has never been and will never be sufficient runoff to provide the required flow. In such cases, this is a natural constraint on the productivity of the river.

The flow prescription development process inherently includes judgments about the relative weighting of priority species and life stages. Although the process is a deductive, scientifically and empirically based approach, management priorities and environmental conditions can change.

Therefore, the prescriptions could be expected to change in response to shifts in priorities and conditions.

4.2 Limitations of the Analysis

4.2.1 Reach delineation

The scale for the reach delineation process does not necessitate (or allow for) breaks at every tributary, due to either (1) a lack of significant hydrologic effect, (2) a lack of substantive or known fisheries use, and/or (3) a lack of tributary flow data. As a result, tributaries such as Mud Creek, West Little Walla Walla, East Little Walla Walla, Garrison Creek and Birch Creek are not independently analyzed. For purposes of the flow prescriptions presented in this report, the scale of reach delineation is appropriate, but the level of precision does not separately account for every tributary or other relatively small source of water gain or loss. Nevertheless, these sources may make additional contributions to the flow regime, water quality, and fisheries habitat needed to support salmonids and other species of concern to the CTUIR in the Walla Walla River Basin. In addition, they provide a “buffer” water supply to meet flow prescriptions during drier periods.

4.2.2 Limiting factors approach

This limiting factor approach seeks to eliminate habitat-related bottlenecks to the productivity of priority species in the Walla Walla River Basin. The results often identify minimum instream flow as a primary variable limiting instream habitat and water temperature in the basin. Increased stream flow during appropriate time periods will typically improve water quality, reduce passage barriers caused by temperature or low flows, and generally increase suitable rearing and/or spawning habitat. Adjusting only one variable in the basin may not solve all water quality, habitat condition and channel condition issues; even as one limiting factor is resolved, the next limiting factor may become manifest. For example, increasing flow may improve habitat area in the lower reaches of the Walla Walla and Touchet rivers, but water temperature may remain or become limiting at those locations or a short distance downstream.

In the Mill Creek Basin, water temperatures are affected not only by flow, but also by changes to channel conditions for flood control such as very wide or concrete-lined channels that tend to exacerbate high water temperature problems. In the absence of a water temperature model for this basin, the precise flow threshold for achieving significant improvement in temperatures is currently unknown.

Beyond improvements to stream flow, this limiting factors analysis did not identify specific restoration and management actions that can be implemented to address the other limiting factors. Prescriptions for other broad categories of actions may be necessary to improve recovery of priority species in the basin.

4.2.3 Hydrology analysis

As noted previously in the methods section, there are limitations to the hydrology information in the basin that require certain assumptions, or impose limitations, on the generation of ‘representative’ hydrology information or related analyses. Various assumptions and/or general limitations of the analysis are noted below.

- The ‘representative’ dataset still constitutes an altered flow regime in the Walla Walla Basin. It is assumed that even the earliest data represent at least some impaired flow conditions due to irrigation and other human alterations.
- The ‘representative’ low flow calculations in the Walla Walla River and Mill Creek assume no gains or losses in flow throughout the length of the channel; i.e., they do not account for gains or losses from smaller tributaries and groundwater interactions.
- Low flow datasets, in some cases, do not span a desirable length of time because of the lack of available gage data. The low flow values are not anticipated to suffer greatly from the limited dataset because baseflows result largely from groundwater inputs and these do not fluctuate greatly over shorter time periods. High flow datasets in this study typically span a much longer period of analysis than the low flow datasets.
- Levees impose a constraint on floodplain inundation frequency. The use of flood magnitude characteristics to infer ecological benefits is limited to areas where levees do not exist. For example, levees typically constrain the flow within a limited area, and prevent flood flows from spreading out over the floodplain. As flood magnitudes increase, and the discharge within in the river is constrained within a levee, the additional conveyance capacity of the channel flushes sediment and water downstream that would otherwise have been maintained by roughness features in the channel or slower water velocities created from water inundating the floodplain. Within a leveed system, as flows increase, ecological benefits may be lost due to high velocities and suitable habitat elimination, in contrast to the positive benefits of small flood flows for floodplain features in non-leveed areas.
- The use of mean daily values as compared with the instantaneous peak values results in under-prediction of peak flow discharges. Due to the limited extent of gage data, these flood prediction data inherently have limited precision and, therefore, results should be used to determine the approximate magnitude of flows and not identified as precise estimates of discharge. In most reaches, the actual discharges associated with the recurrence will be higher than represented here because the hydrology datasets are lacking several smaller tributary inflows.
- Geologic controls on stream flow patterns (e.g., duration and magnitude of runoff) have not been considered, and are documented to be an important variable in low flow characteristics (Tague and Grant 2004).
- Although ’representative’ flows were approximated, very few data, if any, are completely unimpaired for the period of record available in the basin. Euro-American influence on the river system began in the late 1800s and stream gages did not exist in the basin prior to 1903. However, the high flow records were computed from the longest continuous period of record available. Although the stream flow data used to calculate the high flows are partially impaired, the working assumption is that high flows occur during the spring when few stream withdrawals occur. Therefore, the computations are believed to be appropriate as an approximation of the magnitude of the high flows.

4.3 Study Needs

4.3.1 Temperature model

The two primary limiting factors in the Walla Walla River, Mill Creek, and Touchet River basins are low summer/fall flow and high water temperature. Minimum flows for supporting adequate physical habitat (i.e., adequate depth, velocity, and substrate) can be recommended on the basis of data from the PHABSIM studies. However, if water temperatures are excessive, the quantity and quality of physical habitat is of no consequence and water supplied for physical habitat improvements may not benefit the fishery. Although varying amounts of water temperature data are available to document where and when water temperatures may be limiting, no water temperature models have been constructed to determine what, if any, changes in flow or in-river conditions (such as shade) would be necessary to reduce temperatures to a suitable range. Without such information, a hypothetical action to double the flow and WUA of a specific reach may only result in twice as much thermally unsuitable habitat.

4.3.2 Hydrology model and gaging data

The stream gage network in the Walla Walla Basin is sparse or with limited years of operation in many areas. Data from Walla Walla Basin gaging stations consisted mostly of short term, non-concurrent records, and no gage predated significant diversions in the Walla Walla River Basin. Hydrologic knowledge in the basin is limited by the period of record, continuity of data, and lack of information on diversions from the tributaries. Significant improvement could be made in the understanding of the hydrology of the basin with better knowledge of the extent of flow gains and losses through tributary inflow and groundwater interactions with the varying instream flow amounts. The recurrence interval flows of the 2- and 7-year magnitude were used in this report because of their general acceptance in scientific literature. These high flow magnitudes could lose their ecological meaning in reaches that are leveed, incised, or straightened. A better understanding of the flow variability and inundation of high flows is needed to better understand the benefits gained from different high flow events.

4.3.3 PHABSIM model simulations

PHABSIM data were available for many of the reaches analyzed for this study, and updated (in 2013) model simulations and habitat suitability criteria were used in the Walla Walla River basin. However, results for the Touchet River and Mill Creek basins (Barber et al. 2001, 2003) have not been evaluated with updated habitat suitability criteria (or for additional species or life stages), and such an analysis may be useful in the future if the original PHABSIM model data are available.

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Appendices

Appendix A

Conceptual Habitat Maintenance and Fish Instream Flow Assessment Process

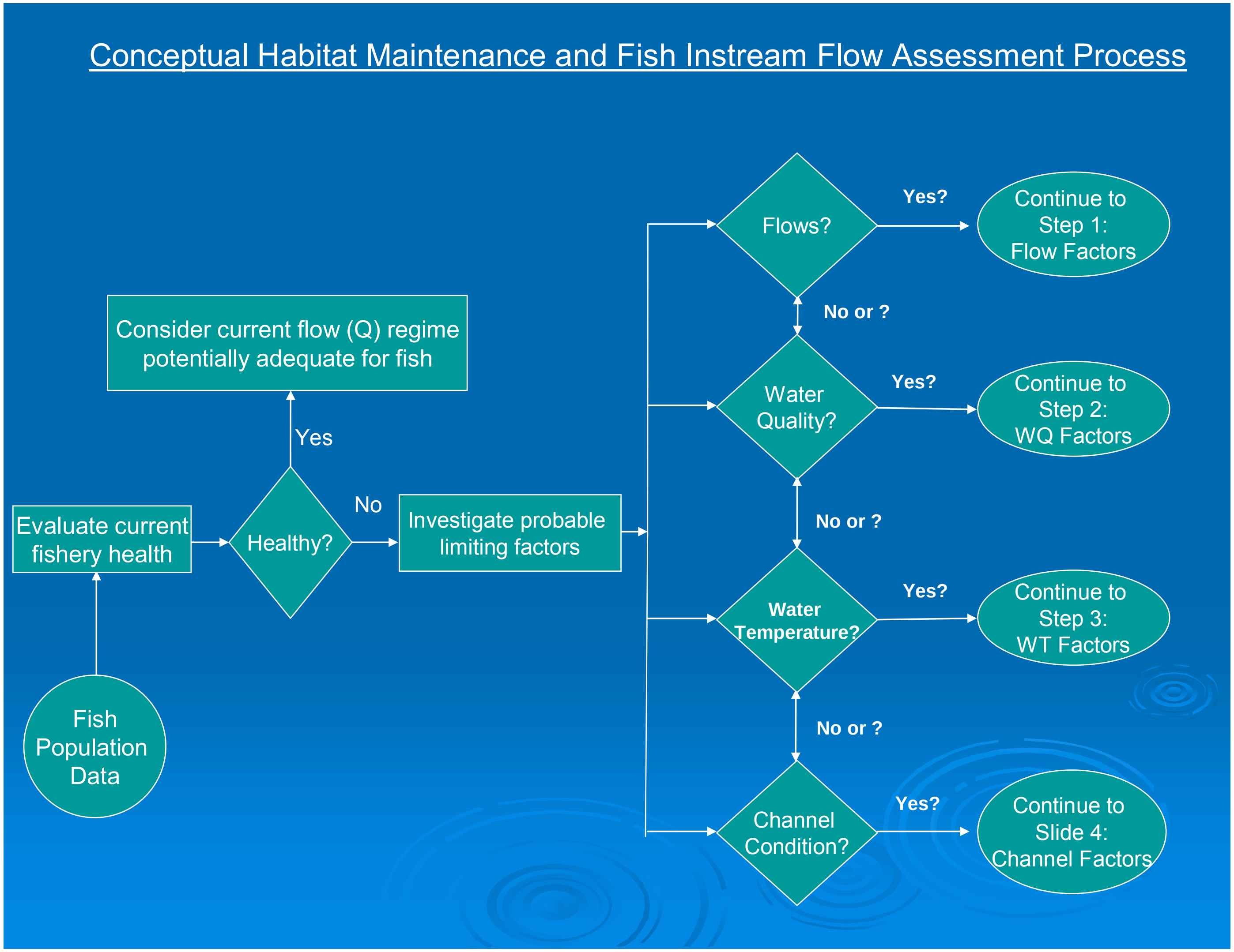

Figure A-1. Conceptual habitat maintenance and fish instream flow assessment process overview.

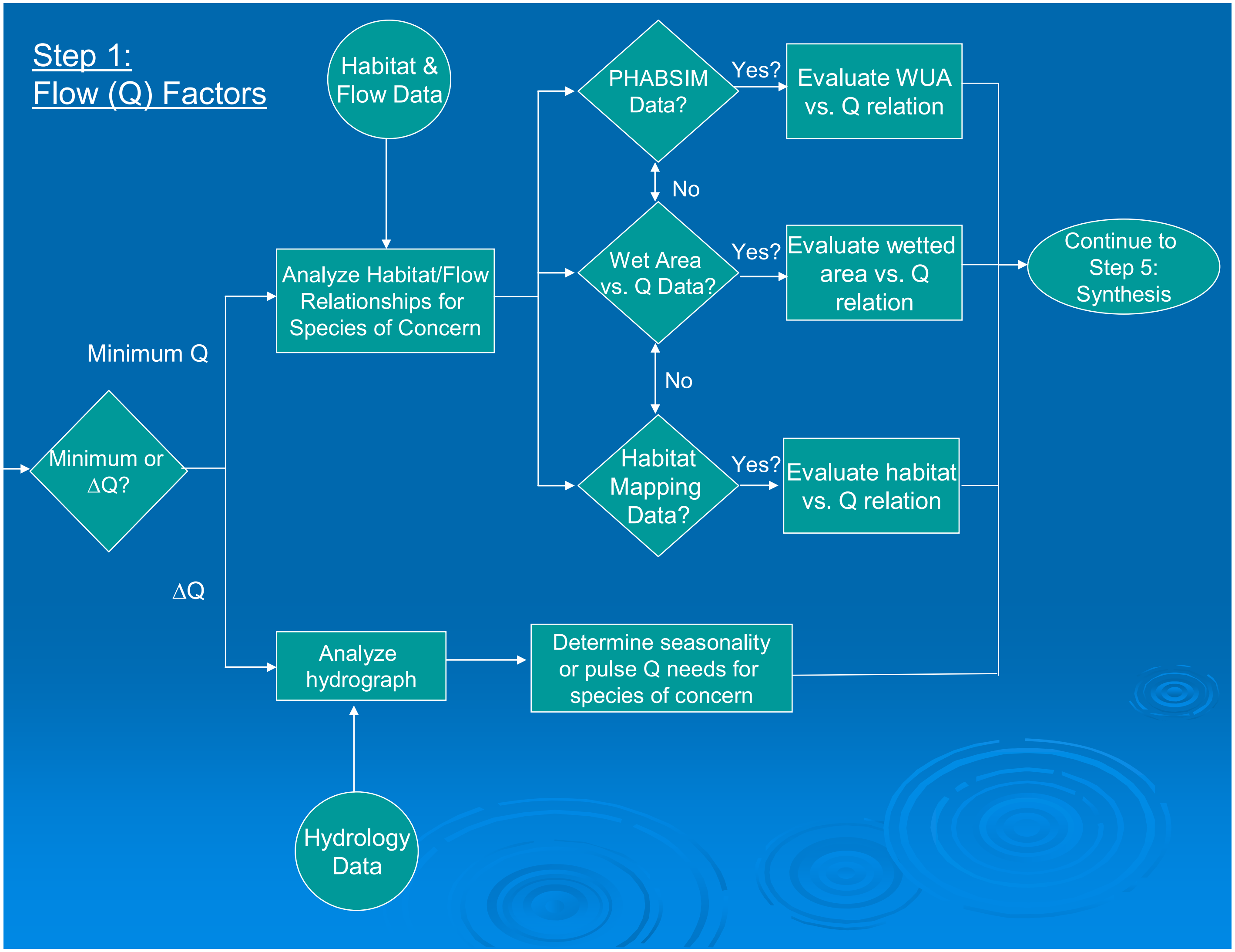

Figure A-2. Conceptual habitat maintenance and fish instream flow assessment process-Step 1 flow factors.

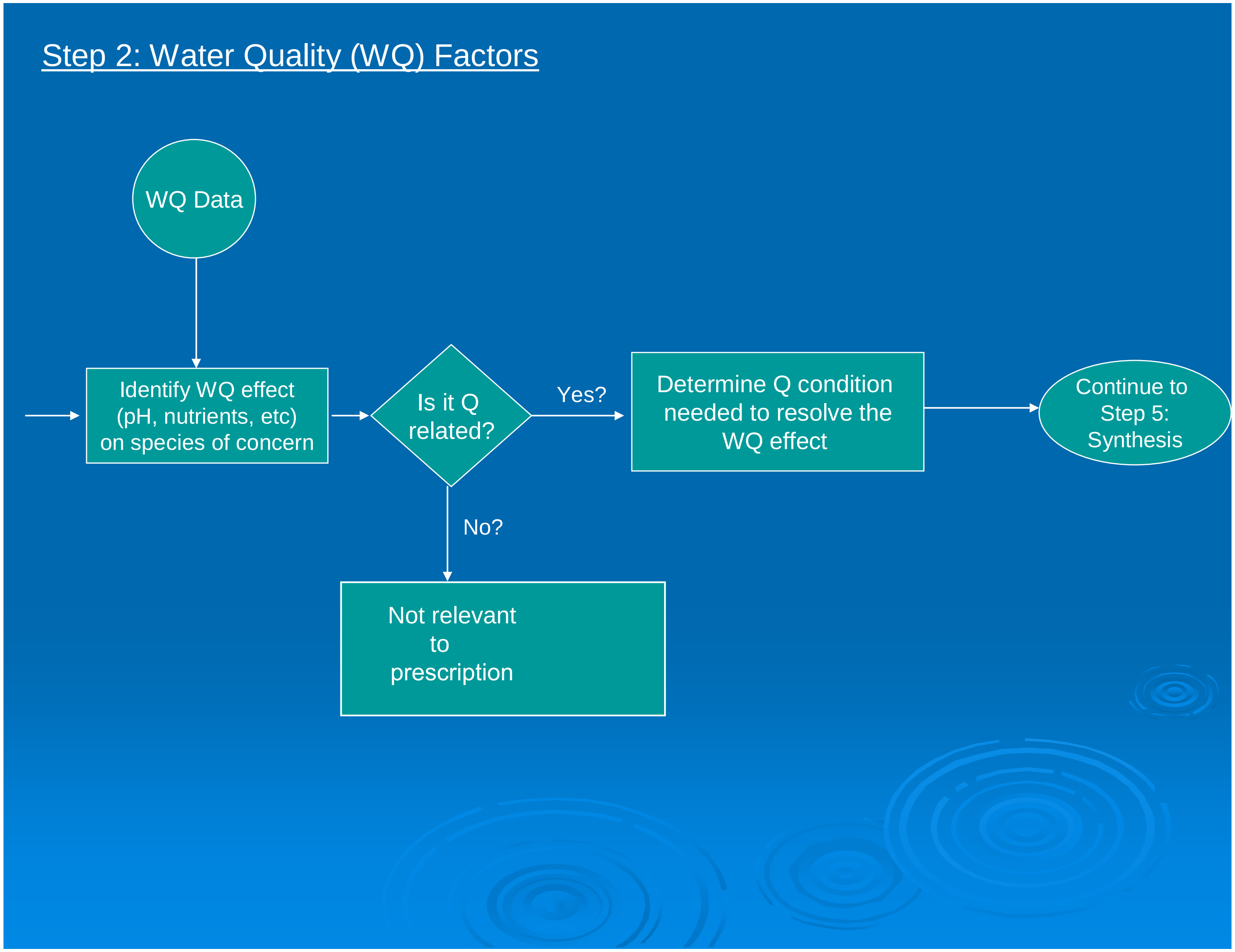

Figure A-3. Conceptual habitat maintenance and fish instream flow assessment process–Step 2 water quality factors.

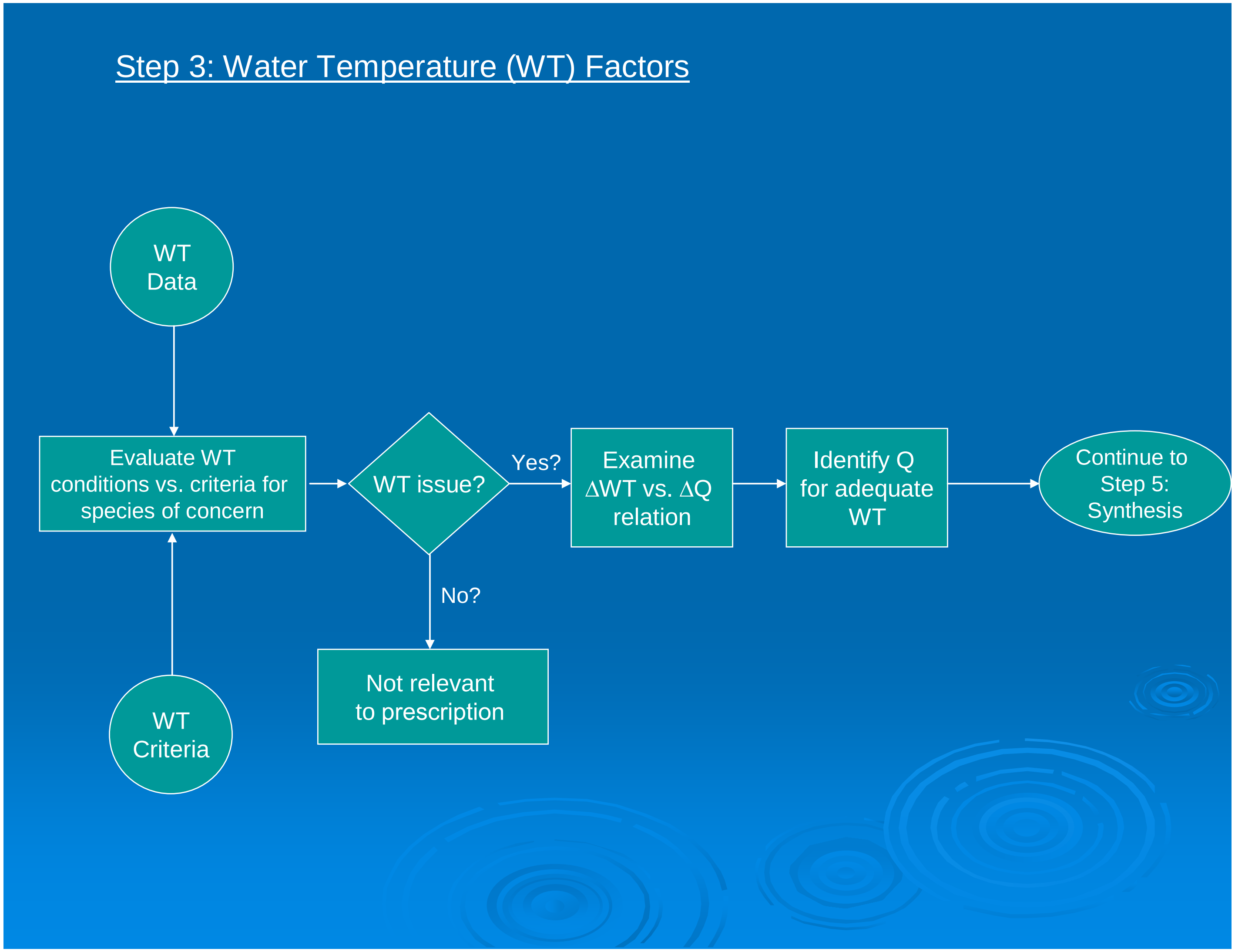

Figure A-4. Conceptual habitat maintenance and fish instream flow assessment process–Step 3 water temperature factors.

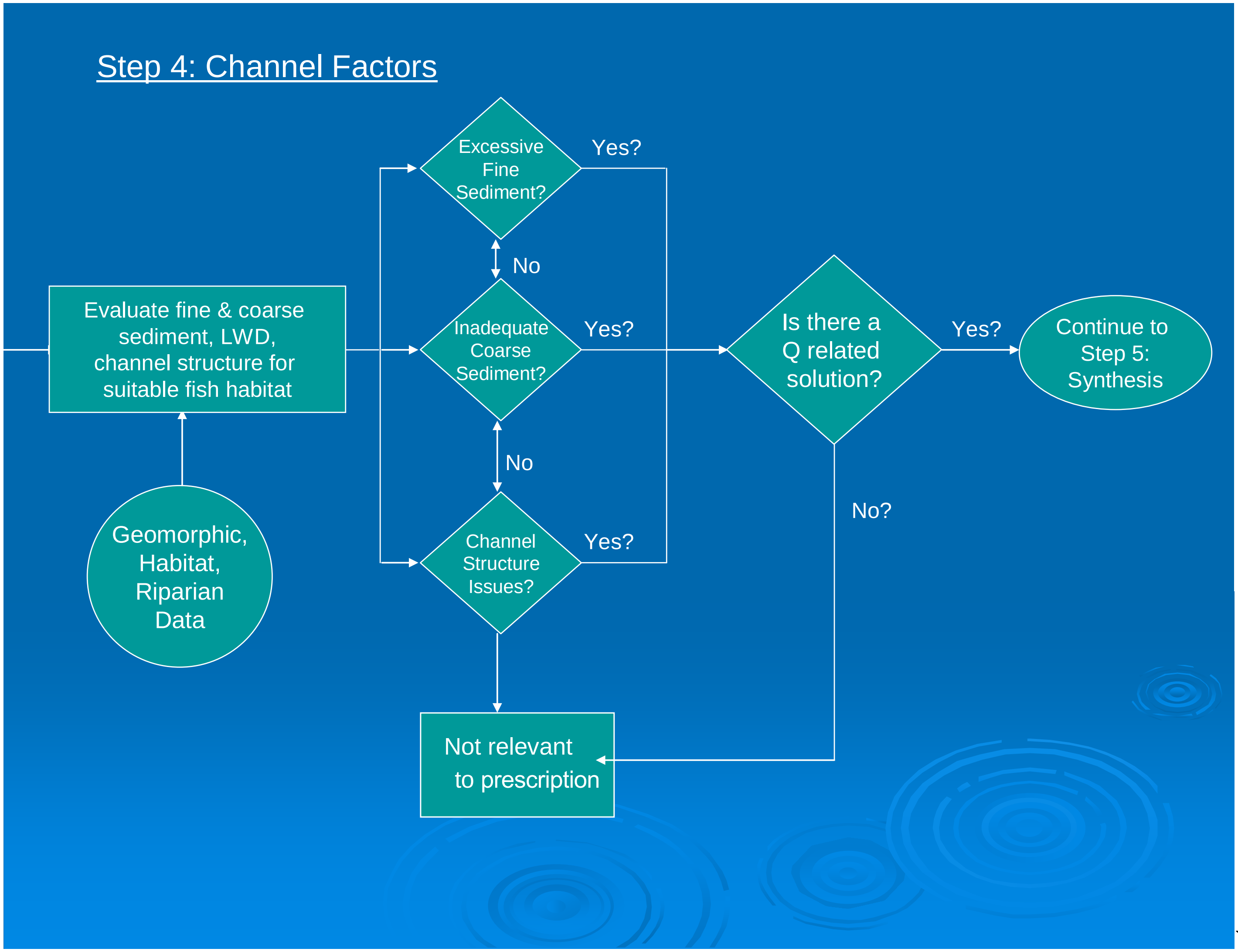

Figure A-5. Conceptual habitat maintenance and fish instream flow assessment process–Step 4 channel factors.

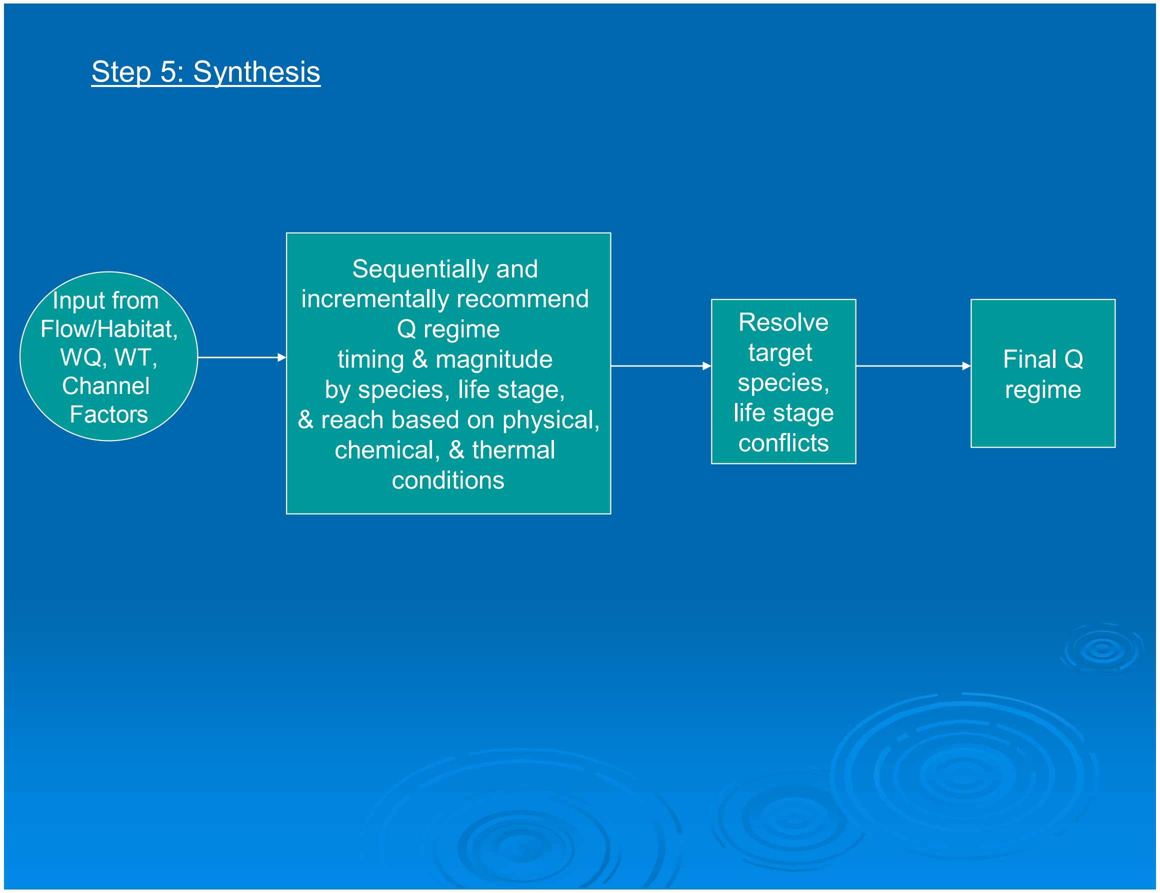

Figure A-6. Conceptual habitat maintenance and fish instream flow assessment process-Step 5 synthesis.

Appendix B

Limiting Factors Analysis by Reach, Priority Species, and Life Stage for the Walla Walla River, Mill Creek, and Touchet River

Table B-1. Crosswalk table for linking mid-Columbia River basin life stage terminology to life stages identified in Table B-2, Limiting Factors Analysis.

Expert panel life stage terminology used in mid-Columbia River basin		LFA life stages identified for flow prescriptions (Appendix D)
1	Spawners, Adults and Eggs	Adult migration/Holding/Spawning
2	Eggs	Incubation/emergence
3	Alevins/Yolk-sac fry	Incubation/emergence
4	Fry	Fry
5	Parr/Fingerling	Juvenile rearing
6	Smolts/Yearling	Juvenile rearing
7	Adults/Ocean	Not addressed
8	Adults/Freshwater Migration	Not addressed

Table B-2. Limiting factors analysis by reach, priority species, and life stage for the Walla Walla River, Mill Creek, and Touchet River. Limiting conditions are identified with an 'x', conditions that were not limiting are identified with an 'o', and data gaps were left blank. Shading indicates critical life stages of priority species and major limiting factors. Instream flows are set for critical life stages with 'high' priority during time period. Flows are also set to ensure viability of life stages with 'moderate' priority.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
South Fork Walla Walla River	Spring Chinook	Adult migration	May–Jul	High: spawning occurs in this reach					17–19	20.1–24.6 (MB)	No data	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	May-Jul	High: spawning occurs in this reach			x		15.6		Temperature exceeds 15.6°C, duration varies by year[2]. Flows/habitat—Lacks adequate holding pools in the lower reach[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Aug–Oct	High: spawning occurs in this reach			o		12.6–13.9		Temperatures exceed 13.9°C in August for short periods of time[2].	
		Incubation/ emergence	Oct–Mar	High: spawning occurs in this reach					11–12.8			
		Fry rearing	Apr–Oct	High: rearing occurs in this reach			o		15.2–18.1		Temperature does not exceed 18.1°C threshold[7].	
		Juvenile rearing	Year round	High: rearing occurs in this reach			o	x	15.2–18.1	21.1–23.4 (L)	Temperature does not exceed 18.1°C threshold[7]. Flows/habitat—summer low flows are a limiting factor[4].	
	Bull trout	Adult migration	May–Jun and Oct-Nov	High: spawning occurs in this reach			x	x	10–14	20.7–21.8 (L)	Temperature exceeds 14°C by early June[7]. Flows/habitat—low summer and fall flows were identified as a potential limiting factor[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	High: spawning occurs in this reach					7.3–8.3			
		Incubation/ emergence	Oct–May	High: spawning occurs in this reach					5.7–7.4		No data	
		Juvenile rearing	Year round	High: rearing occurs in this reach			x		12.6–13.9	21 (L)	Temperature exceeds 13.9°C June through August, does not exceed lethal threshold of 21°C[7]. Flows/habitat—low summer and fall flows were identified as a potential limiting factor[4].	
	Summer Steelhead	Adult migration	Jan-Apr	High: spawning occurs in this reach					17–19	21–26 (L) 20.1–24.6 (MB)		Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach			x	x	12.6–13.9		Summer maximum water temperature and summer flow were identified as limiting factors for summer steelhead egg incubation[4].	Maintain adequate water temperature and habitat conditions
		Fry rearing	Apr–Oct	High: rearing occurs in this reach			o		15.2–18.1		Temperatures are within protective criteria[7].	Maintain adequate water temperature and habitat conditions
		Juvenile rearing	Year round	High: rearing occurs in this reach			o	x	15.2–18.1	21.1–23.4 (L)	Temperatures are within protective criteria[7]. Summer low flows were identified as a limiting factor for steelhead rearing[4].	Maintain adequate water temperature and habitat conditions
		Juvenile outmigration	Oct-Jun	Moderate: migrate downstream in this reach						20.1–24.6 (MB)		Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
North Fork Walla Walla River	Spring Chinook	Not present									North Fork does not support spring Chinook.	
	Bull trout	Adult spawning migration	May–Jun	Low: no migration					10–14	20.7–21.8 (L)	North Fork does not support these life stages of bull trout.	
		Spawning	Sept–Oct	Low: no spawning					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: no spawning					5.7–7.4			
		Juvenile rearing	Apr–Oct	Moderate: some rearing of smaller size class			x	x	12.6–13.9	21 (L)	Temperature exceeds 13.9°C June–September[7]. Stream flow very low in summer, pools may be isolated.	Maintain suitable temperatures to promote growth and survival
	Summer Steelhead	Adult migration	Feb-May	High: spawning occurs in this reach					17–19	21–26 (L) 20.1–24.6 (MB)		Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach					12.6–13.9			
		Fry rearing	Apr–Oct	High: rearing occurs in this reach			x		15.2–18.1		Temperature exceeds 18°C July and August of most years of recorded data—flow and weather dependent[7].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing occurs in this reach			x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 18°C July and August of most years of recorded data; temperature exceeded 21°C for a week duration—flow and weather dependent[7]. Stream flow very low in summer, pools may be isolated.	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: migrate downstream in this reach						20.1–24.6 (MB)		
Walla Walla River Reach 6	Spring Chinook	Adult migration	May–Jul	High: spawning occurs in this reach	x				17–19	20.1–24.6 (MB)	Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jun-Jul	High: holding occurs in this reach	x		x	x	15.6		Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4]. Temperature consistently exceeds 15.6°C in August[7]. Flows/habitat—summer flow was identified as a limiting factor for prespawn Chinook[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Aug–Oct	High: spawning occurs in this reach	x		x	x	12.6–13.9		Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4]. Temperature exceeds 13.9°C through mid-September and decreases through the remainder of spawning season[7].	Maintain adequate water temperature and habitat conditions
		Incubation/ emergence	Oct–Mar	High: spawning occurs in this reach	x				11–12.8		Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levees, no shade in reach[4].	Maintain adequate water temperature and habitat conditions
		Fry rearing	Apr–Oct	High: spawning occurs in this reach	x		o		15.2–18.1		Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levees, no shade in reach[4]. Temperature occasionally exceeds 18°C in August—not every year[7].	Maintain adequate water temperature and habitat conditions
		Juvenile rearing	Year round	High: rearing occurs in this reach	x		o	x	15.2–18.1	21.1–23.4 (L)	Temperature occasionally exceeds 18°C in August—not every year[7]. Flows/habitat—summer flow was identified as a limiting factor for Chinook rearing[4].	Maintain adequate water temperature and habitat conditions

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River Reach 6 (cont.)	Bull trout	Adult migration	May–Jun and Oct-Nov	High: migrate to spawning grounds higher in watershed	x		x	x	10–14	20.7–21.8 (L) 20.1–24.6 (MB)	Temperature exceeds 14° C in late June, stays below 20.1°C[2]. Flows/habitat—low summer and fall flows were identified as a potential limiting factor[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in watershed					5.7–7.4			
		Juvenile rearing	Year round	Moderate: low density rearing in reach	x		x		12.6–13.9	21 (L)	Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levees, no shade in reach[4]. Temperature exceeds 13.9°C July–August, does not exceed 21°C[7].	Maintain adequate water temperature and habitat conditions
	Summer Steelhead	Adult migration	Jan-Apr	High: migrating through this reach	x			o	17–19	21–26 (L) 20.1–24.6 (MB)	Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach	x		o	x	12.6–13.9		Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4]. Summer maximum water temperature and summer flow were identified as limiting factors for summer steelhead egg incubation[4].	Maintain adequate water temperature and habitat conditions
		Fry rearing	Apr–Oct	High: spawning occurs in this reach	x		o		15.2–18.1		Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4]. Temperature occasionally exceeds 18.1°C in August—not every year[7].	Maintain adequate water temperature and habitat conditions
		Juvenile rearing	Year round	High: rearing occurs in this reach	x		o	x	15.2–18.1	21.1–23.4 (L)	Temperature occasionally exceeds 18°C in August—not every year[2]. Flows/habitat—summer flow was identified as a limiting factor for summer steelhead rearing[4].	Maintain adequate water temperature and habitat conditions
		Juvenile outmigration	Oct-Jun	Moderate: rearing occurs in this reach	x					20.1–24.6 (MB)	Channel is confined between levees, widened and altered by Milton Freewater flood control project; contains concrete and rock revetments, trees are removed from levee, no shade in reach[4].	Promote successful outmigration.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Couse Creek	Spring Chinook	Not present										
	Bull trout	Not present										
	Summer Steelhead	Adult migration	Feb–May	High: migration occurs in this reach	x			o		21–26 (L) 20.1–24.6 (MB)	Down cutting, erosion and embeddedness in lower basin[15]. Poor quality habitat in lower basin; upper basin habitat conditions are a data gap. Flows are likely adequate to allow upstream migration[8].	Maintain suitable temperature to ensure adult survival and avoid reduced egg viability.
		Spawning/incubation/ emergence	Mar–May	High; spawning occurs in this reach	x			o	12.6–13.9		Down cutting, erosion and embeddedness in lower basin[15]. Poor quality habitat in lower basin; upper basin habitat conditions are a data gap. Flows are likely adequate to support these life stages[8].	Maintain adequate temperature and habitat conditions.
		Fry rearing	Apr–Oct	High: rearing occurs in this reach	x		x	x	15.2–18.1		Down cutting, erosion and embeddedness in lower basin[6]. High temperatures may affect rearing[15]. Reduced flows occur June–October[8] and limits rearing habitat[6]. Low floodplain connectivity in lower basin, limited riparian zone and low pool frequency[15].	Maintain adequate temperature and habitat conditions.
		Juvenile rearing	Year round	High: rearing occurs in this reach	x		x	x	15.2–18.1	21–23.4 (L)	Down cutting, erosion and embeddedness in lower basin[15]. High temperatures may affect rearing[15]. Reduced flows occur June–October[8] and limits rearing habitat[15]. Low floodplain connectivity in lower basin, limited riparian zone and low pool frequency[15].	Maintain adequate temperature and habitat conditions.
		Juvenile outmigration	Oct-Jun	Moderate: outmigration occurs in this reach						20.1–24.6 (MB)		Promote successful outmigration.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River—Reach 5	Spring Chinook	Adult migration	May–Jun	High: migrate to spawning grounds higher in watershed	x	x	o	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature below 20.1°C through June most years—in 2007, temperature exceeded threshold by mid-June[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: spawn higher in watershed					15.6			
		Spawning	Aug–Oct	Moderate: low density spawning in this reach	x	x	x	x	12.6–13.9		Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 13.9°C August–mid-October[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–Mar	Moderate: low density spawning in this reach	x	x	x	x	11–12.8		Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 12.8°C in October—decreases to suitable range through remaining period[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	Moderate: low density spawning in this reach	x	x	x	x	15.2–18.1		Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 18.1°C June–August[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	Moderate: low density rearing occurs in this reach	x	x	x	x	15.2–18.1	21.1–23.4 (L)	Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 21.1°C June–August[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Jun	High: migrate to spawning grounds higher in watershed	x	x	x	x	10–14	20.7–21.8 (L)	Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 14°C in mid-May most years[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in watershed					5.7–7.4			
		Juvenile rearing	Year round	Moderate: low density rearing in this reach	x	x	x	x	12.6–13.9	21 (L)	Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 21°C June–August[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River Reach 5 (cont.)	Summer Steelhead	Adult migration	Feb–May	High: migrate through this reach	x	x	o	x		21–26 (L) 20.1–24.6 (MB)	Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature below 20.1 C through June most years—one year exceeded 20.1°C by mid-June[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach	x		x	x	12.6–13.9		Temperature exceeds 21.1 late June–early September[2]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[1].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Fry rearing	Apr–Oct	High: rearing occurs in this reach	x	x	x	x	15.2–18.1		Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 18.1 June–August[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain adequate water temperature and habitat conditions
		Juvenile rearing	Year round	High: rearing occurs in this reach	x	x	x	x	15.2–18.1	21.1–23.4 (L)	Reach 5 did not meet Special Class A criteria in the TMDL for pH and DO[3]. Temperature exceeds 21.1°C July–August[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach		x	o	x		20.1–24.6 (MB)	Temperature below 20.1°C[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Promote successful outmigration.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Cottonwood Creek	Spring Chinook	Not present										
	Bull trout	Not present										
	Summer Steelhead	Adult migration	Feb–May	High: migration occurs in this reach	x	x	o	o		21–26 (L) 20.1–24.6 (MB)	Channel condition in the lower watershed is considered to be poor[4]; channel condition in the upper watershed is a data gap. High nitrate levels were recorded in lower Cottonwood Creek and the shallow aquifer[2]. Water temperatures measured in lower Cottonwood Creek in May, 2003and 2004 show a diurnal fluctuation of 8–9 °C and mean temperature allows for passage of migrating adults[13]. Average monthly flow for Cottonwood Creek during critical period is adequate[10].	Maintain continuity with Yellowhawk Creek for migration period. Maintain suitable temperature to ensure adult survival and avoid reduced egg viability.
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach			o	o	12.6–13.9		Channel condition in lower watershed is considered poor[4]; channel condition in the upper watershed is a data gap. High nitrate levels were recorded in lower Cottonwood Creek and the shallow aquifer[2]. Temperature in lower basin Average monthly flow for Cottonwood Creek during critical period is adequate[10].	Maintain adequate daily temperature and habitat conditions.
		Fry rearing	Year round	High: spawning occurs in this reach	x		x	x	15.2–18.1		Channel condition in lower watershed is considered poor[4]; channel condition, flow and temperature in the upper watershed are data gaps. A percentage of daily maximum temperatures exceed 18.1°C during the summer months and diurnal fluctuations are approximately 8°C[13]. Flow is discontinuous during irrigation season which may be a natural condition of the stream[8]. Existing flow regime may not be sufficient to support fry rearing.	Maintain adequate daily temperature and habitat conditions.
		Juvenile rearing	Apr–Oct	High: spawning occurs in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel condition in lower watershed is considered poor[4]; channel condition, flow and temperature in the upper watershed are data gaps. A percentage of daily maximum temperatures exceed 21.1°C during the summer months and diurnal fluctuations were approximately 8°C[13]. Flow is discontinuous during irrigation season which may be a natural condition of the stream[8]. Existing flow regime may not be sufficient to support fry rearing.	Maintain adequate daily temperature and habitat conditions.
		Juvenile outmigration	Oct-Jun	Moderate: outmigration occurs in this reach	x		o	o		20.1–24.6 (MB)	Channel condition in lower watershed is considered poor[4]; channel condition, flow and temperature in the upper watershed are data gaps. Average monthly flow for Cottonwood Creek during critical period is adequate[8].	Promote successful outmigration.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Yellowhawk Creek	Spring Chinook	Steelhead are prioritized over Spring Chinook and Bull Trout due to optimization of flows in Mill Creek.							17–19	21.1–23.4 (L) 20.1–24.6 (MB)		
	Bull trout	Steelhead are prioritized over Spring Chinook and Bull Trout due to optimization of flows in Mill Creek.							10–14	20.7–21.8(L)		
	Summer Steelhead	Adult migration	Feb-May	High: Migrate through this reach.	x		o	x	17–19	21–26 (L) 20.1–24.6 (MB)	Streambanks are eroding throughout the stream corridor, high degree of embeddedness and. here are limited pools[4]. Without the diversion from Mill Creek, there would be no flow in the summer[4]. Yellowhawk Creek serves as an alternative route between Walla Walla River Reach 4 and upper Mill Creek[8].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/incubation/emergence	Mar–May	High: spawning occurs in this reach.	x		x	x	12.6–13.9		Streambanks are eroding throughout the stream corridor, high degree of embeddedness[4]. There are limited pools[4]. Without the diversion from Mill Creek, there would be no flow in the summer[4]. Steelhead spawn and rear in Yellowhawk Creek[8].	Maintain suitable habitat. Water temperatures acceptable in winter
		Fry rearing	Apr–Oct	High: spawning occurs in this reach.	x		x	x	15.2–18.1		Streambanks are eroding throughout the stream corridor, high degree of embeddedness[4]. Temperature exceeds 20.5°C in June, maximum temperatures exceed 27°C in July[6]. There are limited pools[4]. Without the diversion from Mill Creek, there would be no flow in the summer[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing occurs in this reach.	x		x	x	15.2–18.1	21.1–23.4 (L)	Streambanks are eroding throughout the stream corridor, high degree of embeddedness[4]. Temperature exceeds 20.5°C in June, maximum temperatures exceed 27°C in July[6]. There are limited pools[4]. Without the diversion from Mill Creek, there would be no flow in the summer[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Sept-May	Moderate: outmigration l occurs in this reach.						20.4–24.6 (MB)		Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River Reach 4	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach			o	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Temperature below 20.1°C through June[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: Spawn higher in watershed					15.6			
		Spawning	Aug–Oct	Low: spawn higher in watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1		Temperature exceeds 14°C in mid-May most years[7]. Flows/habitat—Reduced flow in mainstem Wall Walla occurs downstream of Milton Freewater[4].	
		Juvenile rearing	Year round	Moderate: low density rearing in this reach			x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 21.1°C late June–early September[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain adequate water temperature and habitat conditions
	Bull trout	Adult migration	May–Jun	High: migrate to spawning grounds higher in watershed			o	x	10–14	20.7–21.8 (L)	Temperature below 20°C through June[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in watershed					5.7–7.4			
		Juvenile rearing	Apr–Oct	Moderate: low density rearing in this reach			x	x	12.6–13.9	21 (L)	Temperature exceeds 21°C late June–early September[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain adequate water temperature and habitat conditions
	Summer Steelhead	Adult migration	Nov-Apr	High: migrating through this reach			o	x	17–19	21–26 (L) 20.1–24.6 (MB)	Temperature below 20°C through June[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in watershed					12.6–13.9		Walla Walla Reach 4 does not support spawning or egg incubation of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness[4].	
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1			
		Juvenile rearing	Year round	High: rearing occurs in this reach			x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 21.1°C late June–early September[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Sept-Jun	Moderate: out-migrating through this reach				x		20.1–24.6 (MB)	Summer maximum water temperature and summer flow were identified as limiting factors for summer steelhead yearling rearing and age-2 rearing[2].	Promote successful outmigration.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	**Water quality**	**Water temperature**	**Flows/ habitat**	**Suitable temperature range (C)**	**Lethality (L) or Migration Barrier (MB) based on temperature (C)**		
Walla Walla River Reach 3	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach		x	x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 20.1°C in May[7]. Flows/habitat—low flow was identified as limiting for Chinook migrants[4].	Maintain adequate water temperature during migration
		Adult holding	Jul–Aug	Low: Prespawn holding in upper watershed					15.6			
		Spawning	Aug–Oct	Low: spawn higher in watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1			
		Juvenile rearing	Year round	High: low density rearing in this reach		x	x	x	15.2–18.1	21.1–23.4 (L)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 21.1°C May–August[7]. Flows/habitat—Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain adequate water temperature and habitat conditions
	Bull trout	Adult migration	May–Jun	High: migrate to spawning grounds higher in watershed		x	x	x	10–14	20.7–21.8 (L)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 20.7°C May–August[7]. Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in watershed					5.7–7.4			
		Juvenile rearing	Apr–Oct	Moderate: low density rearing in this reach		x	x	x	12.6–13.9	21 (L)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 21°C May–August[7]. Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to promote growth and survival
	Summer Steelhead	Adult migration	Nov-Apr	Moderate: migrating through this reach		x	x	x	17–19	21–26 (L) 20.1–24.6 (MB)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 20.1°C by mid-May[7]. Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in watershed					12.6–13.9		Walla Walla Reach 3 does not support spawning, egg incubation or juvenile rearing of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness[4].	
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1			
		Juvenile rearing	Year round	Moderate: low density rearing in this reach		x	x	x	15.2–18.1	21.1–23.4 (L)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 21.1°C May–August[7]. Flows/habitat—low flows were identified as limiting for juveniles[3]. Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain adequate water temperature and habitat conditions
		Juvenile outmigration	Sept-Jun	Moderate: out-migrating through this reach		x	x	x		20.1–24.6 (MB)	Reach 3 did not meet Special Class A water quality standards in the TMDL for pH and DO[3]. Temperature exceeds 20.1°C by mid-May[7]. Flows/habitat—low flows were identified as limiting for juveniles[4].	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Dry Creek	Spring Chinook	Not present										
	Bull trout	Not present										
	Summer Steelhead	Adult migration	Mar–May	High: migration occurs in this reach	x		x	o		21–26 (L) 20.1–24.6 (MB)	Streambank erosion and embeddedness are high in lower watershed and are functioning in upper watershed[4]. High sediment load limits water quality downstream of Dixie, WA[4]. Water temperature exceeds 20.1°C in mid-late May in lower basin creating potential migration barrier[6]. Habitat in lower basin is poor[4]; may have effect on migrating adults. Flows are likely adequate for migration.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach	o		x	o	12.6–13.9		Low erosion and embeddedness in upper watershed[4]. Water quality is fair[4]. Temperatures in upper Dry Creek and Mud Creek exceed 13.9°C in May; North Fork temperatures are relatively cool[6].	Maintain adequate temperature and habitat conditions
		Fry rearing	Apr–Oct	High: spawning occurs in this reach	o		x		15.2–18.1		Low erosion and embeddedness in upper watershed[4]. Water quality is fair[4]. Temperatures in upper Dry Creek and Mud Creek exceed 18.1°C in late spring and summer while North Fork temperatures are relatively cool[6]. Habitat quality is good, flow is a data gap.	Maintain adequate temperature and habitat conditions
		Juvenile rearing	Year round	High: rearing occurs in this reach	o		x		15.2–18.1	21.1–23.4 (L)	Low erosion and embeddedness in upper watershed[4]. Water quality is fair[4]. Temperatures in upper Dry Creek and Mud Creek exceed 18.1°C in late spring and summer while North Fork temperatures are relatively cool[6]. Habitat quality is good, flow is a data gap.	Maintain adequate temperature and habitat conditions
		Juvenile outmigration	Sept-Jun	Moderate: migration occurs in this reach	o		x	o		20.1–24.6 (MB)	Flows and temperature are likely suitable to support outmigration.	Promote successful outmigration

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River Reach 2	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach			x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Reach 3 exceeds 20.1 C in May—assume Reach 2 fails[7]. Flows/habitat—reduced flows impacts migration[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: prespawn holding in upper watershed					15.6		Walla Walla Reach 2 does not support spawning, egg incubation or juvenile rearing of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Spawning	Aug–Oct	Low: spawn higher in watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1			
		Juvenile rearing	Oct-Jun	Moderate: rearing higher in watershed			x	x	15.2–18.1	21.1–23.4 (L)	Reach 3 exceeds 20.1°C in May—assume Reach 2 exceeds suitable temperature range[7]. Flows/habitat—reduced key habitat impacts life stage[4].	
	Bull trout	Adult migration	May–Jun	High: migrate to spawning grounds higher in watershed			x	x	10–14	20.7–21.8 (L)	Reach 3 exceeds 20.7°C in May—assume Reach 2 exceeds migration barrier threshold[7]. Flows/habitat—reduced flows impacts migration[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in watershed					7.3–8.3		Walla Walla Reach 2 does not support spawning, egg incubation or juvenile rearing of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Incubation/ emergence	Oct–May	Low: spawn higher in watershed								
		Juvenile rearing	Apr–Oct	Low: rearing higher in watershed					12.6–13.9	21 (L)		
	Summer Steelhead	Adult migration	Oct-Apr	Moderate: migrating through this reach			x		17–19	21–26 (L) 20.1–24.6 (MB)	Riparian zone in lower mainstem Walla Walla is absent and dikes limit floodplain connectivity[1]. Temperature: Reach 3 exceeds 20.1°C in May—assume Reach 2 fails[7]. Flows/habitat—Reduced key habitat quantity[4].Reduced flows in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in watershed					12.6–13.9		Walla Walla Reach 2 does not support spawning, egg incubation or juvenile rearing of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Fry rearing	Apr–Oct	Low: spawning higher in watershed					15.2–18.1			
		Juvenile rearing	Apr–Oct	Low: rearing higher in watershed					15.2–18.1	21.1–23.4 (L)		
		Juvenile outmigration	Sept-Jun	Moderate: out-migrating through this reach			x	x		20.1–24.6 (MB)	Reach 3 exceeds 20.1°C in May—assume Reach 2 exceeds migration barrier threshold[7]. Flows/habitat—reduced key habitat impacts life stage[4].	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Pine Creek	Spring Chinook	Not present										
	Bull trout	Not present										
	Summer Steelhead	Adult migration	Oct-Apr	Moderate: migration occurs in this reach	x					21–26 (L) 20.1–24.6 (MB)	Lower stream channel is deeply incised, high levels of embeddedness, no riparian zone.. Mean temperatures measured in lower basin May 2003 did not exceed 20.1°C; maximum daily temperature exceeded 20.1°C in late May[6]. Temperatures greater than 21°C occur throughout the summer[4]. Fish passage in lower Pine Creek is a concern due to low flows; White Ditch and Hudson Bay Bridge Road present seasonal passage issues[11]. Flow is discontinuous in lower basin during the irrigation season; mean monthly flow indicates upstream spawning migration is possible[10].	Maintain suitable temperature to ensure adult survival and avoid reduced egg viability.
		Spawning/ incubation/ emergence	Apr-May	High: spawning occurs in this reach					12.6–13.9		Spawning likely occurs in upper watershed above confluence with Dry Creek; 0+ and 1+ RBT/steelhead were found in surveys[8]. Upper watershed habitat and flow conditions data lacking.	Maintain adequate temperature and habitat conditions.
		Fry rearing	Apr-Feb	High: spawning occurs in this reach			x	x	15.2–18.1		Fry rearing likely occurs in upper watershed as 0+ and 1+ RBT/steelhead were found in surveys[8]. No data or descriptions have been found habitat or flow conditions for the upper watershed. Upper watershed habitat and flow conditions data lacking.	Maintain adequate temperature and habitat conditions.
		Juvenile rearing	Apr-Feb	High: rearing occurs in this reach			x	x	15.2–18.1	21.1–23.4 (L)	Most juvenile rearing likely occurs in upper watershed as 0+ and 1+ RBT/steelhead were found in surveys[8]. No data or descriptions have been found for habitat or flow conditions for the upper watershed. Rearing would not be supported under current conditions in the lower watershed. Upper watershed habitat and flow conditions data lacking.	Maintain adequate temperature and habitat conditions.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River Reach 1	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach	x	x	x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Riparian zone in lower mainstem Walla Walla is absent and dikes limit floodplain connectivity[4]. Reach 1 did not meet Class B water quality standards in the TMDL for pH and DO[3]. Temperature—Reach 3 temperatures exceed 20.1°C in May, assume Reach 1 fails[7]. Flows/habitat—Reduced key habitat quantity[4]. Reduced flows in Walla Walla River have existed since settlement of basin[4]. High substrate embeddedness in reach[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability.
		Adult holding	Jul–Aug	Low: prespawn holding in upper watershed					15.6		Walla Walla Reach 1 does not support spawning, egg incubation or juvenile rearing of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Spawning	Aug–Oct	Low: spawn higher in watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1			
		Juvenile rearing	Oct-Jun	Moderate: outmigrate through this reach	x	x	x	x	15.2–18.1	21.1–23.4 (L)	Reach 1 did not meet Class B water quality standards in the TMDL for pH and DO[3]. Temperature—Reach 3 exceeds 20.7°C in May, assume Reach 1 fails[7]. Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	
	Bull trout	Adult migration	May–Jun	High: migrate to spawning grounds higher in watershed	x	x	x	x	10–14	20.7–21.8 (L)	Reach 1 did not meet Class B water quality standards in the TMDL for pH and DO[4]. Temperature—Reach 3 exceeds 20.7°C in May, assume Reach 1 fails[7]. Reduced flow in mainstem Walla Walla occurs downstream of Milton Freewater[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in watershed					7.3–8.3		Walla Walla Reach 1 does not support spawning, egg incubation or juvenile rearing of any priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Incubation/ emergence	Oct–May	Low: spawn higher in watershed					5.7–7.4			
		Juvenile rearing	Apr–Oct	Low: rearing higher in watershed					12.6–13.9	21 (L)		

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Walla Walla River Reach 1 (cont.)	Summer steelhead	Adult migration	Oct-Apr	Moderate: migrating through this reach	x	x	x	x	17–19	21–26 (L) 20.1–24.6 (MB)	Riparian zone is absent in the lower mainstem and dikes limit floodplain connectivity[4]. Reach 1 did not meet Class B water quality standards for pH and DO in the TMDL[3]. Water temperature in Reach 3 exceeds 20.1 C in May, assume similar condition in Reach 1 [7]. Flows/habitat—reduced key habitat quantity[4]. Reduced flows in the Walla Walla River have existed since settlement of basin[4]. High substrate embeddedness was observed in Reach 1[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability.
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in watershed					12.6–13.9		Reach 1 does not support spawning, egg incubation, or juvenile rearing of any priority species due to low flows, high temperatures, lack of critical habitat, and high substrate embeddedness[1].	
		Fry rearing	Apr–Oct	Low: rearing higher in watershed					15.2–18.1			
		Juvenile rearing	Apr–Oct	Low: rearing higher in watershed					15.2–18.1	21.1–23.4 (L)		
		Juvenile outmigration	Sept-Jun	Moderate: out-migrating through this reach	x	x	x	x		20.1–24.6 (MB)	Riparian zone in lower mainstem Walla Walla is absent and dikes limit floodplain connectivity[4]. Reach 1 did not meet Class B water quality standards in the TMDL for pH and DO[3]. Temperature—Reach 3 temperatures exceed 20.1 C in May, assume Reach 1 fails[7]. Flows/habitat—Reduced key habitat quantity[5]. Reduced flows in Walla Walla River have existed since settlement of basin[4]. High substrate embeddedness in reach[3].	Promote successful outmigration.

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Mill Creek Reach 5	Spring Chinook	Adult migration	May–Jul	High: migrating through this reach	o		o	o	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Channel substrate and stream banks are stable, little erosion[4]. Summer (June–September) maximum temperatures rarely approached 12°C when measured in 1991[4]. Perennial flow exists in the reach[4]. Pools and large woody debris are infrequent[4]. Residual pool depths average 1.9 feet[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Moderate: holding occurs in this reach			o	o	15.6		See spring Chinook migration above.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Jul-Oct	High: spawning occurs in this reach					12.6–13.9		See spring Chinook migration above.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–Mar	Moderate: spawning in reach	o				11–12.8		See spring Chinook migration above.	Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	High: spawning in reach	o			o	15.8–18.1		See spring Chinook migration above.	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing in reach	o		o	o	15.2–18.1	21.1–23.4 (L)	See spring Chinook migration above.	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Jun and Oct-Nov	High: migrate through this reach	o		o	o	10–14	20.7–21.8 (L)	Channel substrate and stream banks are stable, little erosion[4]. Summer (June–September) maximum temperatures rarely approached 12°C when measured in 1991[4]. Perennial flow exists in the reach[4]. Pools and large woody debris are infrequent[1]. Residual pool depths average 1.9 feet[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	High: spawning in reach					7.3–8.3		See bull trout migration above.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–May	Moderate: spawning in reach	o						See bull trout migration above.	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing occurs in reach	o		o	o	12.6–13.9	21 (L)	See bull trout migration above.	
	Summer Steelhead	Adult migration	Feb–May	High: migrating to this reach	o		o	o	17–19	21–26 (L) 20.1–24.6 (MB)	Channel substrate and stream banks are stable, little erosion[4]. Summer (June–September) maximum temperatures rarely approached 12°C when measured in 1991[1]. Perennial flow exists in the reach[4]. Pools and large woody debris are infrequent[1]. Residual pool depths average 1.9 feet[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawn in this reach	o				12.6–13.9		Channel substrate and stream banks are stable, little erosion[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Fry rearing	Apr–Oct	High: spawn in this reach	o		o	o	15.2–18.1		Summer (June–September) maximum temperatures rarely approached 12°C when measured in 1991[4]. Perennial flow exists in the reach[4]. Pools and large woody debris are infrequent[4]. Residual pool depths average 1.9 feet[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: juveniles rear in this reach	o		o	o	15.2–18.1	21.1–23.4 (L)	See steelhead fry above.	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Apr–May	Moderate: out-migrating through this reach						20.1–24.6 (MB)		Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Mill Creek Reach 4	Spring Chinook	Adult migration	May–Jul	High: migrating through this reach	o		o	o	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	See summer steelhead juvenile rearing above.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Moderate: low density spawning in this reach			o		15.6		See Mill Creek Reach 4 spring Chinook migration above.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Jul-Oct	High: spawn in this reach			o		12.6–13.9		See Mill Creek Reach 4 spring Chinook migration above.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–Mar	Moderate: spawning occurs in this reach					11–12.8		See Mill Creek Reach 4 spring Chinook migration above.	Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	High: spawn in this reach				o	15.2–18.1		See Mill Creek Reach 4 spring Chinook migration above.	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing in reach	o		o	o	15.2–18.1	21.1–23.4 (L)	See Mill Creek Reach 4 spring Chinook migration above.	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Jun and Oct-Nov	High: migrate through this reach	o		o	o	10–14	20.7–21.8 (L)	Summer maximum temperatures rarely approached 12°C when measured in 1991[4]. Perennial flow exists in the reach[4]. Pool frequency and large woody debris are infrequent[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	High: spawning likely occurs in this reach					7.3–8.3			
		Incubation/ emergence	Oct–May	Moderate: spawn in this reach					5.7–7.4			
		Juvenile rearing	Year round	High: juveniles rear in this reach			o	o	12.6–13.9	21 (L)	See bull trout migration above.	Maintain suitable temperatures to promote growth and survival
	Summer Steelhead	Adult migration	Feb-Jun	High: migrating through this reach					17–19	21–26 (L) 20.1–24.6 (MB)		Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Moderate: spawn in this reach					12.6–13.9			Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	High: spawn in reach					15.2–18.1			Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: juveniles rear in this reach	o		o	o	15.2–18.1	21.1–23.4 (L)	Summer maximum temperatures rarely approached 12°C when measured in 1991[4]. Perennial flow exists in the reach[4]. Pool frequency and large woody debris are infrequent[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Apr–May	Moderate: out-migrating through this reach						20.1–24.6 (MB)		Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Blue Creek	Spring Chinook	Not Present										
	Bull trout	Not Present										
	Summer Steelhead	Adult migration	Feb-Apr	High: migrating and spawning in upper portion of basin			o		17–19	21–26 (L)	Lower Blue Creek temperature data collected 2001–2007 shows mean temperature of 18.3°C or less through May[6]. Daily maximum temperature exceeds 21°C in May 2001 only[6].	
		Spawning/ incubation/ emergence	Apr–May	High: spawning in upper portion of basin			o		12.6–13.9		Lower Blue Creek temperature exceeds spawning criteria [6, 15]; spawning occurs in upper basin. Flows are likely adequate for these life stages[8].	
		Fry rearing	Apr–Oct	Moderate: spawning assumed to occur in upper portion of basin			x	x	15.2–18.1		Temperature in lower Blue Creek (RM 0.2) exceeds 18.1°C in June, July and August of most years 2001–2007[6]. Temperature in the upper basin is a data gap. Flows in the lower basin are low from June through October[8].	
		Juvenile rearing	Year round	High: juveniles rear throughout system			x	x	15.2–18.1	21–23.4 (L)	Temperature in lower Blue Creek (RM 0.2) exceeds 18.1°C in June, July and August of most years 2001–2007[6]. Temperature in the upper basin is a data gap. Flows in the lower basin are low from June through October[8].	
		Juvenile outmigration	Oct-Jun	Moderate: outmigrating through this reach			o			20.1–24.6 (MB)	Lower Blue Creek temperature data collected 2001–2007 shows mean temperature of 18.3°C or less through May[6]. Daily max. temp. exceeds 21°C in May 2001 only[6].	

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Mill Creek Reach 3	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach			x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Temperature exceeds 19°C in July[7]. Low summer flows and warm temperatures affect migration[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: spawn higher in the watershed					15.6			
		Spawning	Aug–Oct	Low: spawn higher in the watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in the watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in the watershed					15.2–18.1			
		Juvenile rearing	Year round	Moderate: low density rearing in reach			x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 18.1°C in July[7]. Low summer flows and warm temperatures affect migration[4].	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Jun and Oct-Nov	High: migrate through this reach			x	x	10–14	20.7–21.8 (L)	Temperature exceeds 20.7°C in July[7]. Low summer flows and warm temperatures affect migration[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in the watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in the watershed					5.7–7.4			
		Juvenile rearing	Apr–Oct	Low: little rearing in this reach					12.6–13.9	21 (L)		Maintain suitable temperatures to promote growth and survival
	Summer Steelhead	Adult migration	Feb–May	High: migrating through this reach					17–19	21–26 (L) 20.1–24.6 (MB)	No data to indicate a temperature or flow issue in May.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Moderate: low density spawning in this reach					12.6–13.9		No data to indicate a temperature or flow issue in May.	Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	High: rearing occurs in this reach			x		15.2–18.1		Temperature exceeds 18.1°C July through August[7].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing occurs in this reach			x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 21.1°C July through August[7]. Low summer flows and warm temperatures affect juvenile rearing[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach						20.1–24.6 (MB)		Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Mill Creek Reach 2	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach	x		x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Channel highly altered[4]. Temperature exceeds 21.1°C June through mid-September[7]. Reach experiences low flows during irrigation season[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: spawn higher in the watershed					15.6			
		Spawning	Aug–Oct	Low: spawn higher in the watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in the watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: rearinghigher in the watershed					15.2–18.1			
		Juvenile rearing	Oct-May	Moderate: rearing higher in watershed	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel highly altered[4]. Temperature exceeds 21.1°C June through mid-September[7]. Reach experiences low flows during irrigation season[4].	
	Bull trout	Adult spawning migration	May–Jun and Oct-Nov	Moderate: migrate through this reach	x		x	x	10–14	20.7–21.8 (L)	Channel highly altered[4]. Temperature exceeds 20.7°C June through mid-September[7].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: spawn higher in the watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in the watershed					5.7–7.4			
		Juvenile rearing	Apr–Oct	Low: rearing higher in watershed					12.6–13.9	21 (L)		
	Summer Steelhead	Adult migration	Feb–May	High: migrating through this reach	x		x	x	17–19	21–26 (L) 20.1–24.6 (MB)	Channel highly altered concrete and concrete weirs.[4]	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Feb–May	Low: spawn higher in the watershed					12.6–13.9			
		Fry rearing	Apr–Oct	Low: spawn higher in the watershed					15.2–18.1			
		Juvenile rearing	Oct-Apr	Moderate: poor channel conditions for rearing	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel highly altered[4]. Reach experiences low flows and high temperatures during irrigation season[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach						20.1–24.6 (MB)		

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Mill Creek Reach 1	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach	x		x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Temperature exceeds 20.1°C June through August[7]. Reach experiences low flows during irrigation season.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: spawn higher in the watershed					15.6			
		Spawning	Aug–Oct	Low: spawn higher in the watershed					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: spawn higher in the watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in the watershed					15.2–18.1			
		Juvenile rearing	Year round	High: low density rearing in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel highly altered[4]. Temperature exceeds 20.1°C June through August[7]. Reach experiences low flows during irrigation season[4].	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Jun and Oct-Nov	Moderate: migrate through this reach	x		x	x	10–14	20.7–21.8 (L)	Temperature exceeds 20.7°C June–August[7]. Reach experiences low flows during irrigation season. Little to no fish habitat value[4].	
		Spawning	Sept–Oct	Low: spawn higher in the watershed					7.3–8.3			
		Incubation/ emergence	Oct–May	Low: spawn higher in the watershed					5.7–7.4			
		Juvenile rearing	Apr–Oct	High: low density rearing in this reach	x		x	x	12.6–13.9	21 (L)	Channel highly altered[4]. Temperature exceeds 20.1°C June through August[7]. Reach experiences low flows during irrigation season[4].	Maintain suitable temperatures to promote growth and survival
	Summer Steelhead	Adult migration	Feb-May	High: migrating through this reach					17–19	21–26 (L) 20.1–24.6 (MB)	Data gap.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in the watershed					12.6–13.9			
		Fry rearing	Apr–Oct	Low: spawn higher in the watershed					15.2–18.1		Temperature exceeds 21.1°C[7]. June through August. Reach experiences low flows during irrigation season[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: juveniles rear in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel highly altered[4]. Temperature exceeds 21.1°C[7], June through August. Reach experiences low flows during irrigation season[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach						20.1–24.6 (MB)		

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
North Fork Touchet River	Spring Chinook	Adult migration	May–Jul	High: spawning occurs in this reach	x		x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Channel condition degrades in quality in a downstream trend—increased erosion and bank hardening, diking, high width to depth ratio, high embeddedness and lack of riparian vegetation.[4] Temperature exceeds 20.1°C in mid June[7]. Flows/habitat—Stream does not dewater; diversions are active. Upper North Fork—riparian zone intact, pool quality and pool frequency is low.[4]	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	High: spawning occurs in this reach	x		x	x	15.6		Temperature exceeds 15.6°C July–August[7]. See Chinook migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Aug–Oct	High: spawning occurs in this reach	x		x	x	12.6–13.9		Temperature exceeds 13.9°C till September[7]. See Chinook migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–Mar	Moderate: spawning occurs in this reach	x		o	x	11–12.8		Temperature below 12.8°C February–March[7]. See Chinook migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	Moderate: spawning occurs in this reach	x		x	x	15.2–18.1		Temperature exceeds 18.1°C July through August[7]. See Chinook migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Apr–Oct	High: rearing occurs in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 21.1°C July through August[7]. See Chinook migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Aug	High: spawning occurs in this reach	x		x	x	10–14	20.7–21.8 (L)	Channel condition degrades in quality in a downstream trend—increased erosion and bank hardening, diking, high width to depth ratio, high embeddedness and lack of riparian vegetation.[4] Temperature exceeds 14°C May–September and exceeds 20.7°C July–August[7]. Flows/habitat—Stream does not dewater; diversions are active. Upper North Fork—riparian zone intact, pool quality and pool frequency is low.[4]	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	High: spawning occurs in this reach	x		x	x	7.3–8.3		Temperature exceeds 8.3°C September–October[7]. See bull trout migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–June	Moderate: spawning occurs in this reach	x		o	x	5.7–7.4		Temperature within protective range[7]. See bull trout migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Juvenile rearing	Year round	High: rearing occurs in this reach	x		x	x	12.6–13.9	21 (L)	Temperature exceeds 13.9°C June–September[7]. See bull trout migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	**Water quality**	**Water temperature**	**Flows/ habitat**	**Suitable temperature range (C)**	**Lethality (L) or Migration Barrier (MB) based on temperature (C)**		
North Fork Touchet River (cont.)	Summer Steelhead	Adult migration	Feb-Jun	High: spawning occurs in this reach	x		o	x	17–19	21–26 (L) 20.1–24.6 (MB)	Channel condition degrades in quality in a downstream trend—increased erosion and bank hardening, diking, high width to depth ratio, high embeddedness and lack of riparian vegetation.[4] Temperature below 17°C through May.[7] Flows/habitat—Stream does not dewater; diversions are active. Upper North Fork—riparian zone intact, pool quality and pool frequency is low.[4]	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Feb–May	High: spawning occurs in this reach	x		o	x	12.6–13.9		Temperature below 13.9°C through May—occasional exceedences[7]. See steelhead migration above for channel and habitat/flow conditions.	Maintain suitable habitat. Water temperatures acceptable in winter
		Fry rearing	Apr–Oct	High: spawning occurs in this reach	x		x	x	15.2–18.1		Temperature exceeds 18.1°C July through August[7]. See steelhead migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing occurs in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Temperature exceeds 21.1°C July through August[7]. See steelhead migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach	x		o	x		20.1–24.6 (MB)	Temperature below 20.1°C April–May[7]. See steelhead migration above for channel and habitat/flow conditions.	Maintain suitable temperatures to promote growth and survival
South Fork Touchet River	Spring Chinook	Not present									Spring Chinook are not present in South Fork Touchet.	
	Bull trout	Not present									Bull Trout not Present in South Fork Touchet.	
	Summer Steelhead	Adult migration	Feb-Jun	High: migrating through this reach				o	17–19	21–26 (L) 20.1–24.6 (MB)	Flows are not discontinued during adult and juvenile migration between South Fork Touchet and the mainstem[1].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach	x		x	x	12.6–13.9		Channel condition is poor due to high levels of erosion and embeddedness and lack of riparian zone[4]. Streambed is highly unstable[1]. Water temperature was identified as a limiting factor for summer steelhead egg incubation[7].	Maintain suitable temperatures to promote growth and survival
		Fry rearing	Apr–Oct	High: spawning occurs in this reach	x		x	x	15.2–18.1			
		Juvenile rearing	Year round	High: rearing occurs in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Summer maximum water temperature was identified as a limiting factor for rearing[4]. Stream bed is composed of highly mobile coarse sediments, preventing formation of stable habitat[4]. Pools are lacking and lower mile of reach dewaters, reducing mobility of juveniles rearing[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach				o		20.1–24.6 (MB)	Flows are not discontinued during adult and juvenile migration between South Fork Touchet and the mainstem[4].	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Touchet River Reach 2	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach	x		o		17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Temperatures below 20.1°C through June[7].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: holding occurs in upper reaches	x		x	x	15.6		Lack of water and high temperature can cause prespawn mortality[4]. Temperature exceeds 15.6°C during critical time period of July and August[7]	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Aug–Oct	Low: low density spawning occurs in upper reaches	x		x	x	12.6–13.9		River confined by levees and dikes.[4] Temperature exceeds 12.6°C in August and September, temperatures exceed 21.1°C depending upon year.[7] Habitat/flows—Pools have low frequency for salmonid requirements, pool quality if fair. Hydrologic regime of reach is altered due to irrigation and floodplain development, reduced summer flows.[4]	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Incubation/ emergence	Oct–Mar	Low: spawn higher in watershed					11–12.8			
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					15.2–18.1			
		Juvenile rearing	Year round	Moderate: low density rearing occurs upstream of Whetstone Creek in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel condition is poor due to high levels of erosion and embeddedness and lack of riparian zone[4]. Temperatures exceed 21.1°C late June through mid-September[7]. Flows/habitat—habitat conditions are poor in Reach 2, low pool frequency and quality[4].	Maintain suitable temperatures to promote growth and survival
	Bull trout	Adult migration	May–Jun and Oct-Nov	High: migrating through this reach			x		10–14	20.7–21.8 (L)	Temperatures exceed 14°C through migration season, but do not exceed migration barrier threshold[7].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: no spawning in reach					7.3–8.3			
		Incubation/ emergence	Oct–June	Low: no spawning in reach					5.7–7.4			
		Juvenile rearing	Apr–Oct	Low: no rearing in reach					12.6–13.9	21 (L)		
	Summer Steelhead	Adult migration	Feb-May	High: migrating through this reach			x		17–19	21–26 (L) 20.1–24.6 (MB)	Temperatures exceed 20.1°C in early May[2].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in watershed					12.6–13.9		Touchet River Reach 2 does not support spawning or egg incubation of any priority species, due to low flows, high temperatures, lack of critical habitat, and high embeddedness.	
		Fry rearing	Apr–Oct	Low: spawn higher in watershed					11–12.8			
		Juvenile rearing	Year round	Moderate: rearing occurs mainly upstream of Whetstone Creek in this reach	x		x	x	15.2–18.1	21.1–23.4 (L)	Channel condition is poor due to high levels of erosion and embeddedness and lack of riparian zone[4]. Temperatures exceed 21.1°C late June through mid-September [7]. Flows/habitat—habitat conditions are poor in Reach 2, low pool frequency and quality[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach			o			20.1–24.6 (MB)	Temperatures below 20.1°C through May[7].	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Coppei Creek	Spring Chinook	Not present										
	Bull trout	Not present										
	Summer Steelhead	Adult migration	Feb-Jun	High: spawning occurs in this reach			o		17–19	21–26 (L) 20.1–24.6 (MB)	Temperature below 17°C February–May[7].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	High: spawning occurs in this reach			x	x	12.6–13.9		Temperature exceeds 13.9°C late April–May[7].	Maintain suitable habitat. Water temperatures acceptable in winter
		Fry rearing	Apr–Oct	High: rearing occurs in this reach		x	x	x	15.2–18.1		Coppei Creek did not meet TMDL criteria for pH for Class A water[3]. Temperature exceeds 18.1°C July–August[7]. Flows/habitat—summer flows are a limiting factor[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile rearing	Year round	High: rearing occurs in this reach		x	x	x	15.2–18.1	21.1–23.4 (L)	Coppei Creek did not meet TMDL criteria for pH for Class A water[3]. Temperature exceeds 21.1°C July–August[7]. Flows/habitat—summer flows are a limiting factor[4].	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: rearing occurs in this reach			o			20.1–24.6 (MB)	Temperature does not exceed 20.1°C[7].	Maintain suitable temperatures to promote growth and survival

Reach	Priority species	Critical life stage	Period of interest	Priority during this time period	Potential limiting factors[1]				Criteria from Washington State Department of Ecology 2002		Notes	Key environmental considerations for flow recommendation
					Channel condition	Water quality	Water temperature	Flows/ habitat	Suitable temperature range (C)	Lethality (L) or Migration Barrier (MB) based on temperature (C)		
Touchet River Reach 1	Spring Chinook	Adult migration	May–Jun	High: migrating through this reach			x	x	17–19	21.1–23.4 (L) 20.1–24.6 (MB)	Temperature exceeds 20.1°C by mid-June[7]. Flows/habitat—irrigation diversions reduce instream flow and can dewater sections of Reach 1[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Adult holding	Jul–Aug	Low: spawn higher in watershed					15.6			
		Spawning	Aug–Oct	Low: no spawning in reach					12.6–13.9			
		Incubation/ emergence	Oct–Mar	Low: no spawning in reach					11–12.8			
		Fry rearing	Apr–Oct	Low: no spawning in reach					15.2–18.1			
		Juvenile rearing	Year round	Moderate: outmigration occurs in reach					15.2–18.1	21.1–23.4 (L)		
	Bull trout	Adult migration	May–Jun	High: migrating through this reach			x	x	10–14	20.7–21.8 (L)	Temperature exceeds 14°C by May[7]. Flows/habitat—irrigation diversions reduce instream flow and can dewater sections of Reach 1[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning	Sept–Oct	Low: no spawning in reach					7.3–8.3			
		Incubation/ emergence	Oct–June	Low: no spawning in reach					5.7–7.4			
		Juvenile rearing	Apr–Oct	Low: no rearing in reach					12.6–13.9	21 (L)		
	Summer Steelhead	Adult migration	Dec-Jun	High: migrating through this reach		x	o	x	17–19	21–26 (L) 20.1–24.6 (MB)	Reach 1 did not meet TMDL standards for Class B water[3], Temperature below 20.1°C through May[7]. Flows/habitat—irrigation diversions reduce instream flow and can dewater sections of Reach 1[4].	Maintain suitable temperatures to ensure adult survival and avoid reduced egg viability
		Spawning/ incubation/ emergence	Mar–May	Low: spawn higher in watershed					12.6–13.9		Touchet River Reach 1 does not support spawning or egg incubation priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Fry rearing	Apr–Oct	Low: rearing higher in watershed					11–12.8		Touchet River Reach 1 does not support spawning or egg incubation priority species, due to low flows, high temperatures, lack of critical habitat and high embeddedness.	
		Juvenile rearing	Year round	Moderate: rearing in reach		x	o	x	15.2–18.1	21.1–23.4 (L)	The CTUIR consider outmigration to encompass rearing activity.	Maintain suitable temperatures to promote growth and survival
		Juvenile outmigration	Oct-Jun	Moderate: out-migrating through this reach		x	o	x		20.1–24.6 (MB)		Maintain suitable temperatures to promote growth and survival

1 Channel condition, water quality, water temperature and habitat/flow were considered as limiting factors.
Conditions considered limiting for a life stage of a species were marked with an 'x'. Conditions not considered limiting were marked with an 'o'.
Data gaps were left blank.
2 EES 2002.
3 Joy et al. 2007.
4 Kuttel 2001.
5 Walla Walla County and Walla Walla Basin Watershed Council 2004a
6 Mendel et al. 2007
7 Appendix E
8 Mahoney et al. 2012
9 Mahoney et al. 2006
10 Appendix C
11 B. Zimmerman, CTUIR, pers. comm., June 2012
12 Table 9
13 Mendel et al. 2004
14 Mendel et al. 2003
15 Volkman and Sexton 2003

Appendix C

Stetson Hydrology Memo

DRAFT MEMORANDUM

STETSON ENGINEERS INC.
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TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: julianf@stetsonengineers.com

TO:	Stillwater Sciences	DATE:	August 24, 2012
FROM:	Julian Fulwiler	JOB NO:	2119-003

RE: Hydrology Datasets for the Walla Walla Ecological Flow Study

This memorandum summarizes the development of flow datasets for Blue Creek, Couse Creek, Pine Creek, Dry Creek, Cottonwood Creek, and upper Mill Creek. The location of these subbasins and the gages used in this study are shown in Figure 1. The objective was to produce flow datasets representing natural or unimpaired flow to the greatest extend possible. Due to limitations, such as the location of gaging stations, impairment of gaged records, and poor records of surface flow diversions in the watershed, some of these datasets do not fully represent natural flow. Specifics of these limitations are discussed below for each creek.

1. Blue Creek

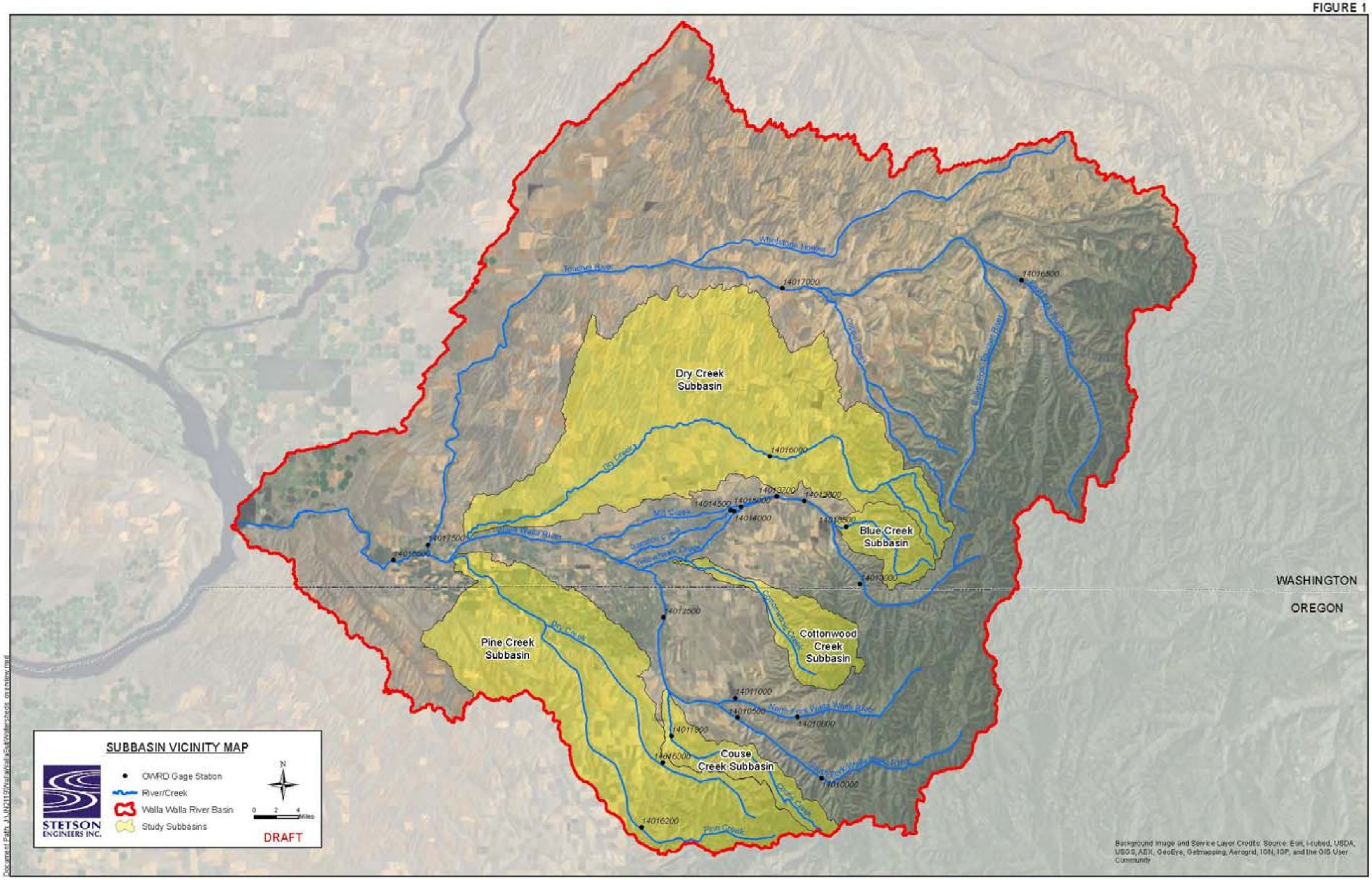
Blue Creek is a tributary of Mill Creek and drains high elevation land extending towards the eastern edge of the Walla Walla River Basin (WWRB). The Blue Creek subbasin drains 19.7 square miles and the average annual total precipitation in the basin averages about 45.1 inches[1]. Flow patterns for Blue Creek consist of high flows during spring and winter months (December through May) and a low flow period between June through October or November. Peak runoff events generally result from intense rainfall on saturated ground or rainfall on snow events.

Flow data for Blue Creek is available from a USGS gaging station (14013500) located about 0.9 miles upstream from its confluence with Mill Creek. The gaging station was in operation from 10/1/1939 through 9/30/1971, providing 32 years of daily flow records. USGS Water Supply Papers from that time period indicate there were no diversions or regulation above the station. Therefore the USGS gaged records for Blue Creek can be considered natural, unimpaired flow.

The USGS gaging period for the Blue Creek gage is sufficiently long to provide a good record of flow data and was not extended in this study. In the future, if a longer period of record is needed, the Blue Creek gaged flows correlate well (R^2=0.88) with Mill Creek gaged flows (1403000). A flow frequency figure for the USGS gaged flows is provided in Figure 2. The daily flow dataset and monthly and annual flow summaries are provided in a separate Excel file titled BLUE CREEK_1.xls.

[1] All average annual and monthly total precipitation values in this memorandum were developed from 1971-2000 normals obtained from OSU PRISM Climate Group datasets.

FIGURE 1



Dry Creek Subbasin
Blue Creek Subbasin
Cottonwood Creek Subbasin
Pine Creek Subbasin
Couse Creek Subbasin
WASHINGTON
OREGON
Touchet River
Whetstone Hollow
Dry Creek
Mill Creek
Walla Walla River
Yellowhawk Creek
Cottonwood Creek
North Fork Walla Walla River
Pine Creek
14017000
14016500
14016000
14013700
14012800
14014500
14015000
14014000
14013500
14017500
14018500
14013000
14012500
14011000
14010500
14010800
14011800
14016300
14010000
14016200
SUBBASIN VICINITY MAP
OWRD Gage Station
River/Creek
Walla Walla River Basin
Study Subbasins
STETSON ENGINEERS INC.
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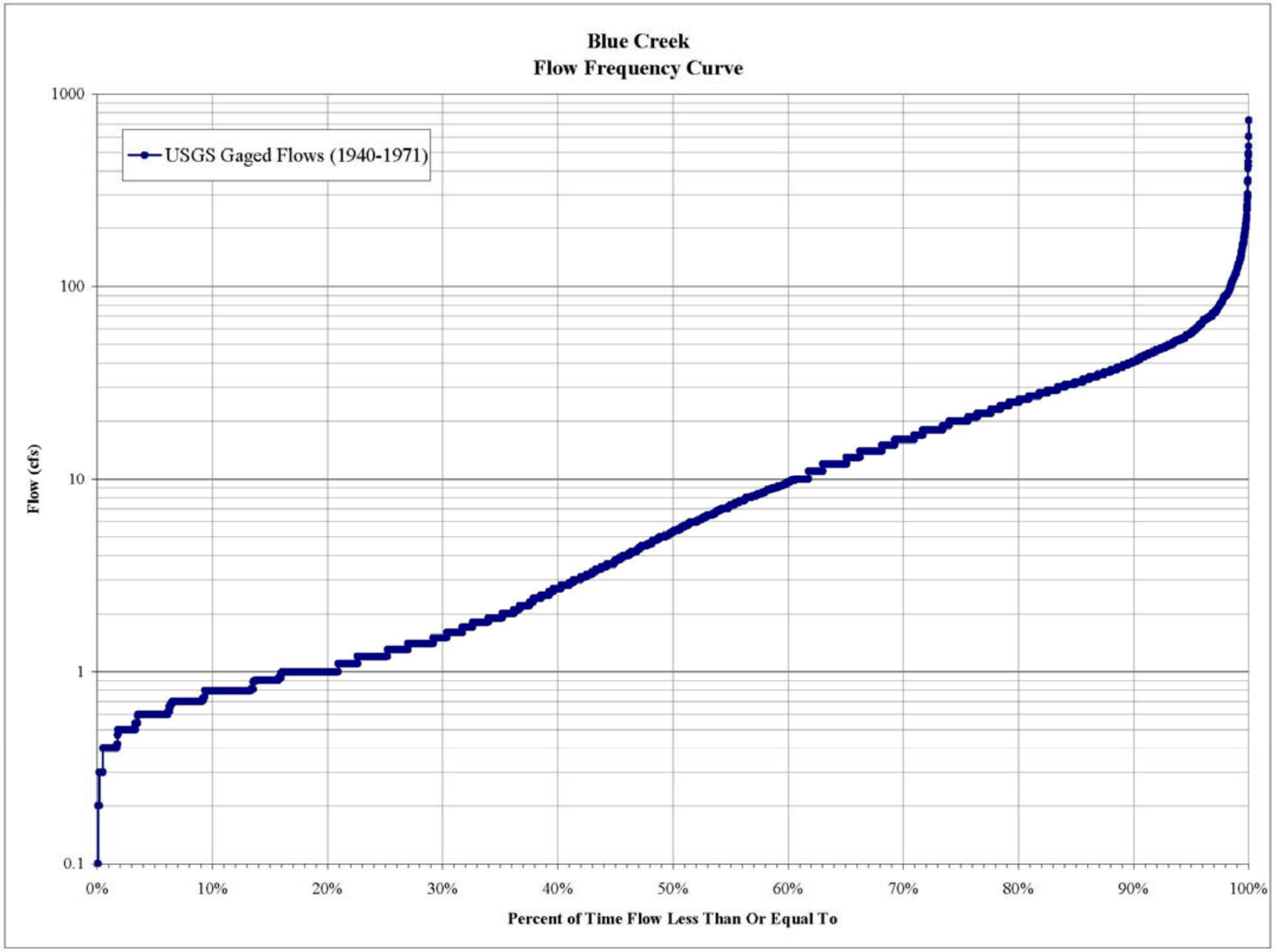

Blue Creek
Flow Frequency Curve
USGS Gaged Flows (1940-1971)
Flow (cfs)
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Less Than Or Equal To

DRAFT

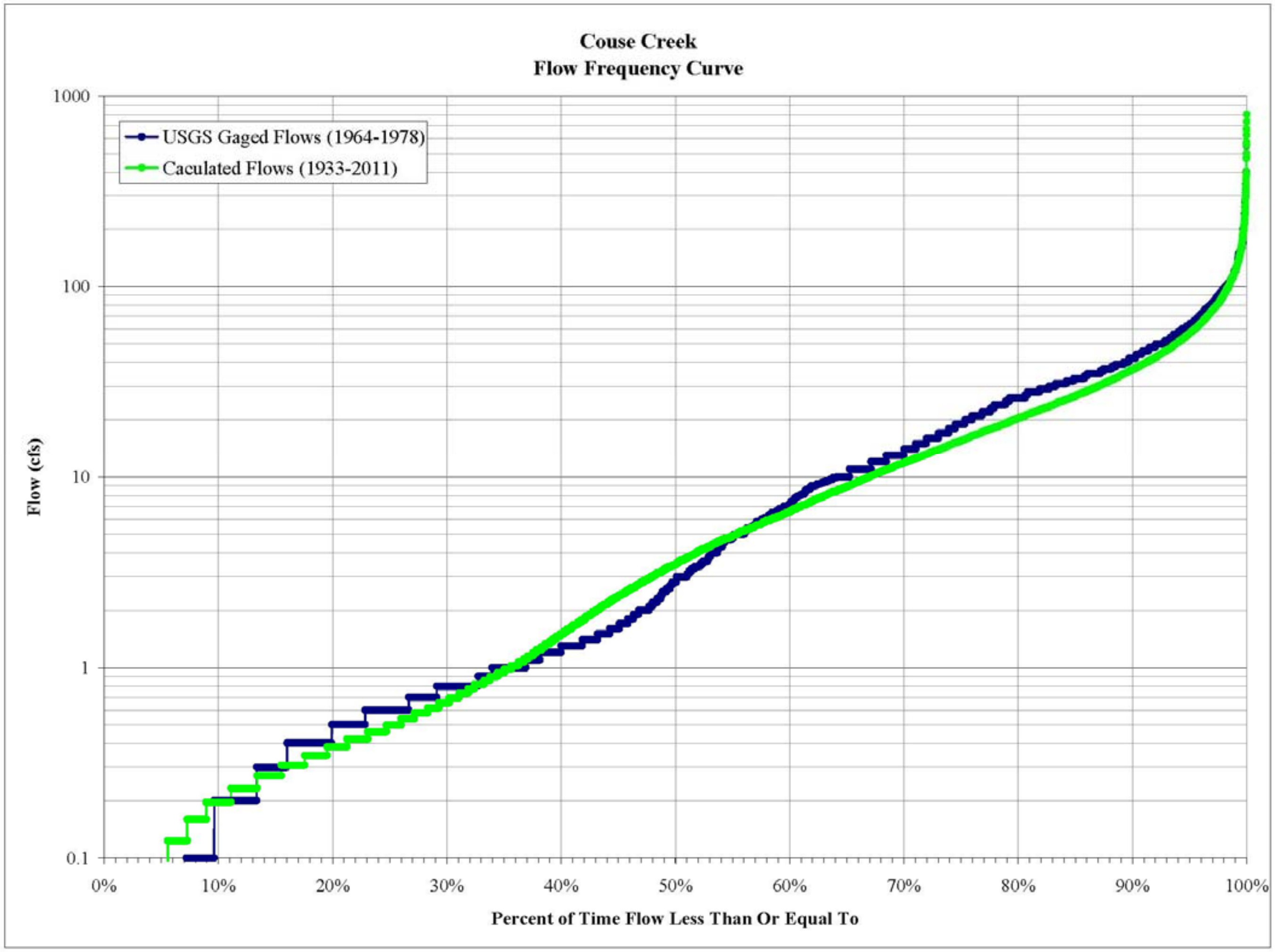
2. Couse Creek

Couse Creek is a tributary to the Walla Walla River draining 24.7 square miles in Oregon. The average monthly total precipitation in the basin ranges from 0.6 inches in July to 3.9 inches in November, and the annual subbasin average is 28.9 inches. Peak runoff for Couse Creek generally occurs in April and May and the low flow period extends from July through October. The gaged flow record indicates Couse Creek can experience periods of zero flow during the months of July through October.

Flow data for Couse Creek is available from a USGS gaging station (14011800) located approximately 3.1 miles upstream from the confluence with the Walla Walla River. The gaging station was in operation from 11/10/1964 through 12/19/1978, provided 12 complete years of daily flow data. The level of impairment for USGS gaged flows on Couse Creek is unknown. Based on aerial photos, the headwaters of Couse Creek would have been undeveloped and the largest irrigation likely occurred downstream from the gage. However, it is likely some diversions occurred upstream from the gage, impairing the gaged flow record. Therefore, the gaged flows during the period of record were likely somewhat impaired during the irrigation (summer) season. No records exist for these historical diversions and no attempt was made in this analysis to add an estimated quantity of diverted flow back into the gaged flow record. As a result, the flow dataset developed for Couse Creek is conservative and likely underestimates the natural flow during the summer months.

The limited period of record was extended based on a daily regression analysis. Correlations with flow data from several USGS gages in the Walla Walla and Umatilla Basins were examined before the Umatilla River above Meacham Creek gage (14020000) was selected as the reference gage. Daily flows from Couse Creek and the Umatilla River above Meacham Creek displayed a strong correlation (R^2=0.88). Additionally the Umatilla gage has a long period of record, is unimpaired (USGS Water Supply Papers for the Umatilla River above Meacham Creek indicate no regulation or diversions above the gage), and the upper Umatilla River also drains the Blue Mountains and follows a similar hydrologic regime to many of the Walla Walla subbasins. Using a logarithmic equation developed from the regression, 78 years of daily Couse Creek flows were calculated from water year 1934 through 2011 based on Umatilla River flows. A combined record was then developed from the Couse Creek USGS gaged flows and the calculated flows.

Flow frequency figures for Couse Creek USGS gaged flow and calculated flow is provided in Figure 3. The daily flow dataset and monthly and annual flow summaries are provided in a separate Excel file titled COUSE CREEK_1.xls.


Couse Creek
Flow Frequency Curve
USGS Gaged Flows (1964-1978)
Caculated Flows (1933-2011)
Flow (cfs)
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Less Than Or Equal To

DRAFT

3. Dry Creek

Dry Creek is a tributary to the Walla Walla River draining 242.8 square miles of lower elevation lands north of Mill Creek. The average monthly total precipitation in the basin ranges from 0.6 inches in July to 2.8 inches in November, and the annual subbasin average is 20.9 inches. Dry Creek receives much less snowfall and winter storage than other higher elevation subbasins and responds more dynamically to rainfall events. This results in winter peaks that are much higher than summer base flows.

Significant irrigation occurs in the Dry Creek subbasin. The Washington Department of Ecology (WDOE) water rights database lists 138 water rights records for Dry Creek. Diversion quantities listed for these water rights total 101.7 cfs and the irrigated area totals 3,090 acres. Actual diversion records from these water rights holders were unavailable.

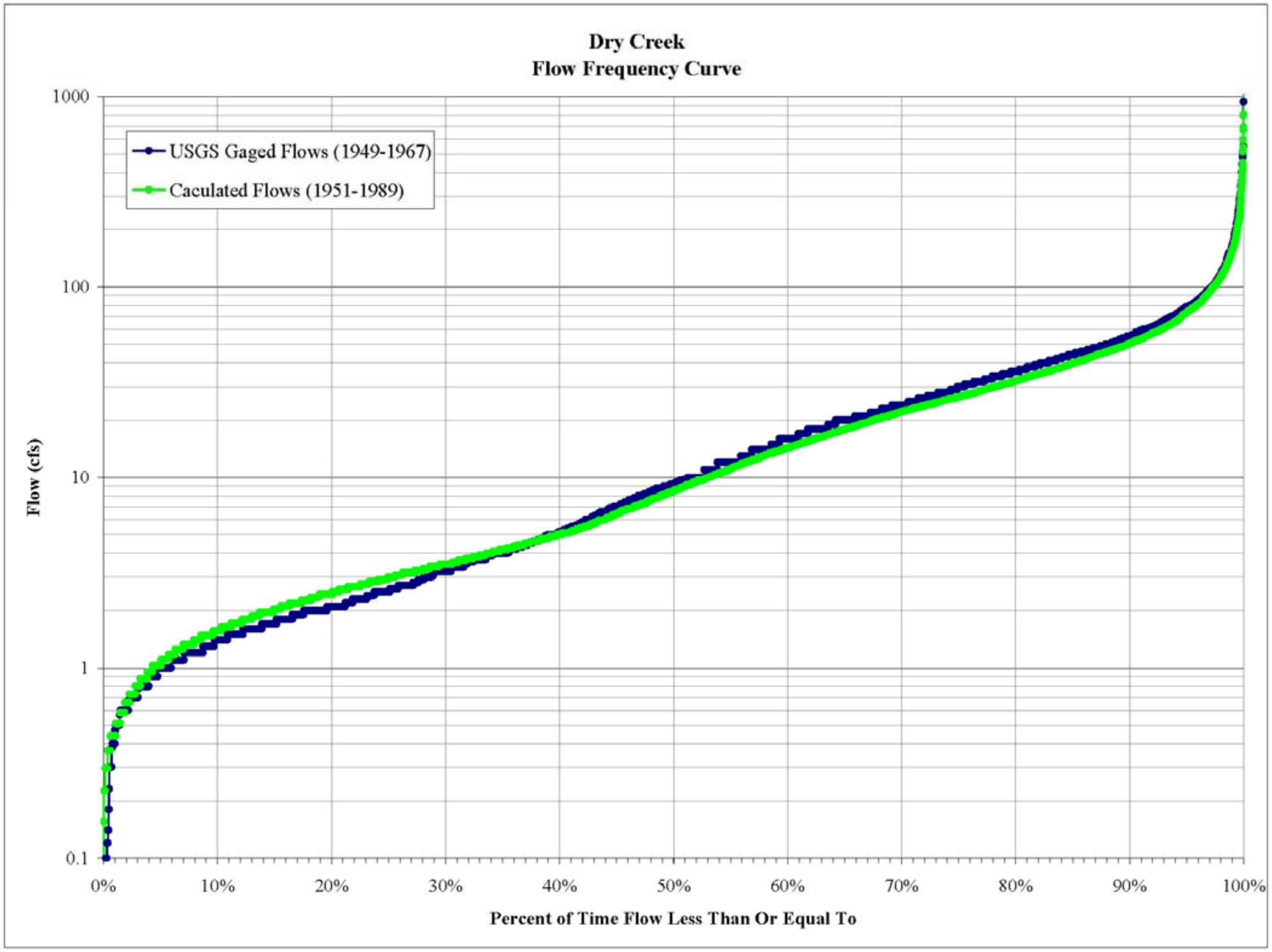
Daily flow data for Dry Creek is available from a USGS gaging station (14016000) located 24.2 miles upstream from the confluence with the Walla Walla River. The gaging station was in operation from 2/1/1949 through 9/30/1967, provided 18 complete years of daily flow data. USGS Water Supply Papers indicate there was no regulation and several small diversions above the station for irrigation during the gaging period for the Dry Creek gage. Therefore, the gaged flows during the period of record were likely somewhat impaired during the irrigation (summer) season. No records exist for these historical diversions and no attempt was made in this analysis to add an estimated quantity of diverted flow back into the gaged flow record. As a result, the flow dataset developed for Dry Creek is conservative and likely underestimates the natural flow during the summer months.

The limited period of record for the Dry Creek gage was extended based on a daily regression analysis. After studying correlations with several USGS gaging stations, the Touchet River at Bolles was selected as the reference station because it also drains lower elevation lands and had a strong correlation with Dry Creek gaged flows (R^2=0.92).

The Touchet River at Bolles gaging station is no longer active, but was active from 2/1/1924 through 9/30/1929 and from 4/1/1951 through 10/10/1989, providing 43 complete years of daily flow data.. Using a developed logarithmic regression equation, the Dry Creek daily flow record was extended to a 40 year period, from water year 1950 through 1989, based on historical Touchet River flows..

Since the USGS Dry Creek gage is located far upstream from the mouth, monthly flows at the confluence with the Walla Walla River were also estimated. The monthly flows at the moth of Dry Creek were calculated based on the flow at the USGS gage location and monthly factors based on drainage area and average monthly precipitation above and below the gage site.

The daily flow dataset and monthly and annual flow summaries are provided in a separate Excel file titled DRY CREEK_1.xls. This file also contains the monthly calculated flow for Dry Creek at the mouth. Flow frequency figures for Dry Creek USGS gaged flow and calculated flow is provided in Figure 4.


Dry Creek
Flow Frequency Curve
USGS Gaged Flows (1949-1967)
Caculated Flows (1951-1989)
Flow (cfs)
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Less Than Or Equal To

DRAFT

4. Pine Creek

Pine Creek and its tributary Dry Creek, drains 167.7 square miles on and near the southwestern edge of the WWRB and discharges into the Walla Walla River just upstream of Touchet. Similar to Dry Creek in Washington, Pine creek receives less snowfall and is a flashy system with high peaks and low summer baseflows. The average monthly total precipitation in the basin ranges from 0.6 inches in July to 2.6 inches in November, and the annual subbasin average is 19.9 inches.

Flow data for Pine Creek is available from a USGS gaging station (14016200) located 26.6 miles upstream from the confluence with the Walla Walla River and 16.8 miles above the Dry Creek confluence. The gaging station was in operation from 10/22/1964 through 9/30/1985, provided 17 complete years of daily flow data. Flow data for Dry Creek (tributary to Pine Creek) is available from a USGS gaging station (14016300). The gaging station was in operation from 10/28/1965 through 9/30/1974, provided 8 complete years of daily flow data.

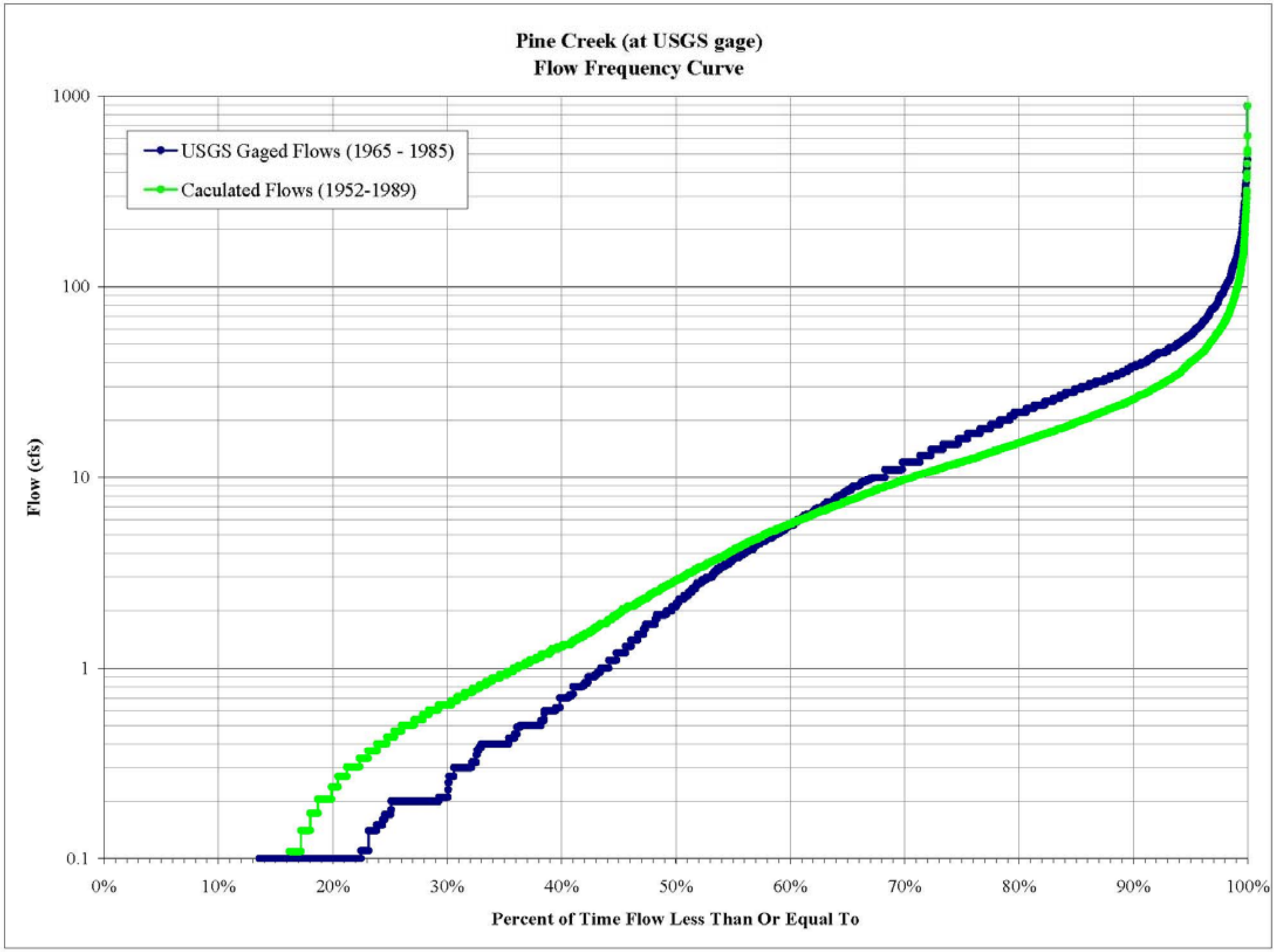
Both Pine Creek and its tributary Dry Creek are significantly impacted by irrigation diversions. Both USGS gages however were located fairly high up in the watershed and the large majority of irrigation diversions would have occurred below the gages for both Pine and Dry Creeks. No records exist for any historical diversions that may have occurred above the gages and no attempt was made in this analysis to add an estimated quantity of diverted flow back into the gaged flow record.

The limited period of record for the Pine Creek gage was extended based on a daily regression analysis. After studying correlations with several USGS gaging stations, the Touchet River at Bolles was selected as the reference station because it also drains lower elevation lands and had a relatively strong correlation with Pine Creek gaged flows (R^2=0.85).

The Touchet River at Bolles gaging station is no longer active, but was active from 2/1/1924 through 9/30/1929 and from 4/1/1951 through 10/10/1989. Using a developed logarithmic regression equation, the Pine Creek daily flow record was extended to a 38 year period, from water year 1952 through 1989, based on historical Touchet River flows.

Flows at the mouth of Pine Creek were estimated by summing synthesized daily flows for Pine Creek (at USGS gage) and Dry Creek. Dry Creek daily flows were estimated based on a relationship with the calculated Pine Creek flow. There were 2,986 days of overlapping flow data for Pine Creek and Dry Creek between 1965 and 1974. The data followed a strong correlation (R^2=0.91) and a logarithmic regression equation was developed. Using the developed Pine Creek flow data from 1952 through 1989, daily flows for Dry Creek were also calculated.

The daily flow dataset for Pine Creek and monthly and annual flow summaries are provided in a separate Excel file titled PINE CREEK_1.xls. This file also contains the calculated flows for Dry Creek. Flow frequency figures for Dry Creek USGS gaged flow and calculated flow is provided in Figure 5.


Pine Creek (at USGS gage)
Flow Frequency Curve
USGS Gaged Flows (1965 - 1985)
Caculated Flows (1952-1989)
Flow (cfs)
1000
100
10
1
0.1
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow Less Than Or Equal To

DRAFT

5. Cottonwood Creek

Cottonwood Creek is a tributary to Yellowhawk Creek and has a drainage area of about 28.8 square miles. The headwaters of Cottonwood Creek reach elevations of over 4,200 feet before dropping into lower elevation lands (below 900 feet elevation) near the City of Walla Walla. The average monthly total precipitation in the basin ranges from 0.8 inches in July to 5.7 inches in November, and the annual subbasin average is 28.9 inches. The upper reaches of Cottonwood Creek include three forks (North, Middle, and South).

Flow data for Cottonwood Creek is extremely limited. The Washington Department of Ecology measured 15-minute flows near the mouth and at Hood Rd during 2003 and 2004. Flow data at Hood Rd location during 2003 shows a period of zero flow in early October and increasing to 0.7 cfs on November 10, 2003, the last day of data. In 2004, flow data was measured from July 1 through November 8 at both locations. A hydrograph of these flow data is presented in Figure 6.

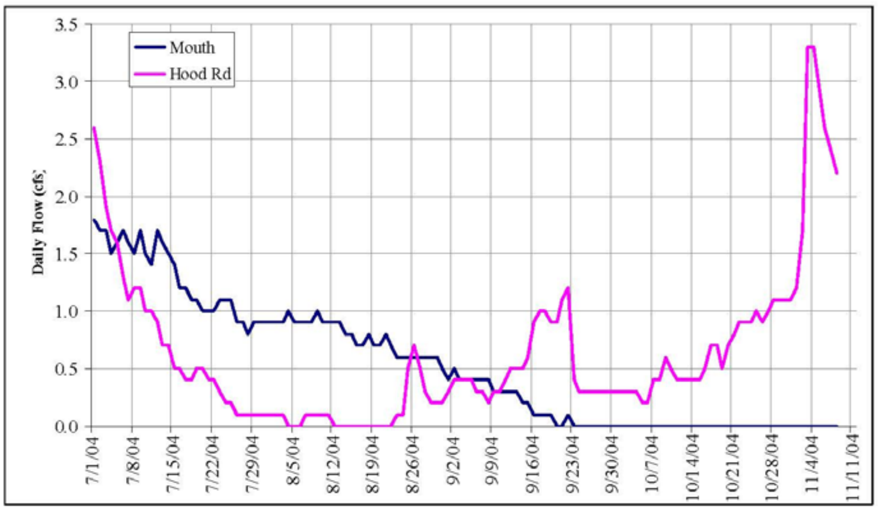


Figure 6. Cottonwood Creek WDOE Gaged Flows, July 1 – November 8, 2004

A synthetic dataset of monthly Cottonwood Creek flows was developed using the Couse Creek flow dataset as the reference gage. Couse Creek and Cottonwood Creek share similar watershed characteristics, including close proximity, similar drainage areas, and similar topography. Cottonwood Creek does receive on average about 10 inches more of total precipitation a year than Couse Creek.

Total monthly Cottonwood Creek flows were calculated using monthly ratios and Couse Creek flows from October 1933 through September 2011. The monthly ratios were developed based on the ratio of drainage areas and the average monthly precipitation of the two subbasins.

Median and minimum monthly flows for Cottonwood Creek were also calculated using the same monthly ratios.

The monthly Cottonwood Creek flow synthesized dataset, and summary tables are provided in a separate Excel file titled COTTONWOOD CREEK_1.xls.

6. Mill Creek

A natural flow dataset was calculated for upper Mill Creek to determine the total natural flow availability at the Mill and Yellowhawk/Garrison confluence. The natural flow for upper Mill Creek was calculated on a daily basis by summing gaged flows at the USGS Kooskooskie station (14013000), gaged flows from Blue Creek (14013500) and estimated historical diversions for the City of Walla Walla. Daily natural flows were calculated for a 40 period from water year 1940 through 1971, which was based on the Blue Creek gaging period of record.

The City of Walla Walla has diverted surface water from Mill Creek, above the Kooskooskie gaging station since the early 1920s. Daily records for the City's diversions from June 2001 through June 2012 were obtained for this study. Average monthly diversions were calculated from this daily diversion dataset and these monthly values, disaggregated evenly throughout each month, were used in the calculation of the Mill Creek natural flow. This was the best available approach given the lack historical diversion data from 1940 through 1971. The daily and monthly 2001-2012 City diversions are shown in Figure 7.

In the late 1980s minimum flow requirements at the Kooskooskie gage were established for the City in relation to its hydropower generation and FERC License. Prior to these minimum flow requirements, the City would often divert at higher rates (up to its 28 cfs water right) and return unused flow back to Mill Creek near the Army Corps flood control project. Therefore, it is likely the average monthly 2001-2012 diversions underestimate what was actual diverted between 1940 and 1971.

The monthly upper Mill Creek natural flow dataset, and summary tables are provided in a separate Excel file titled MILL CREEK_1.xls.

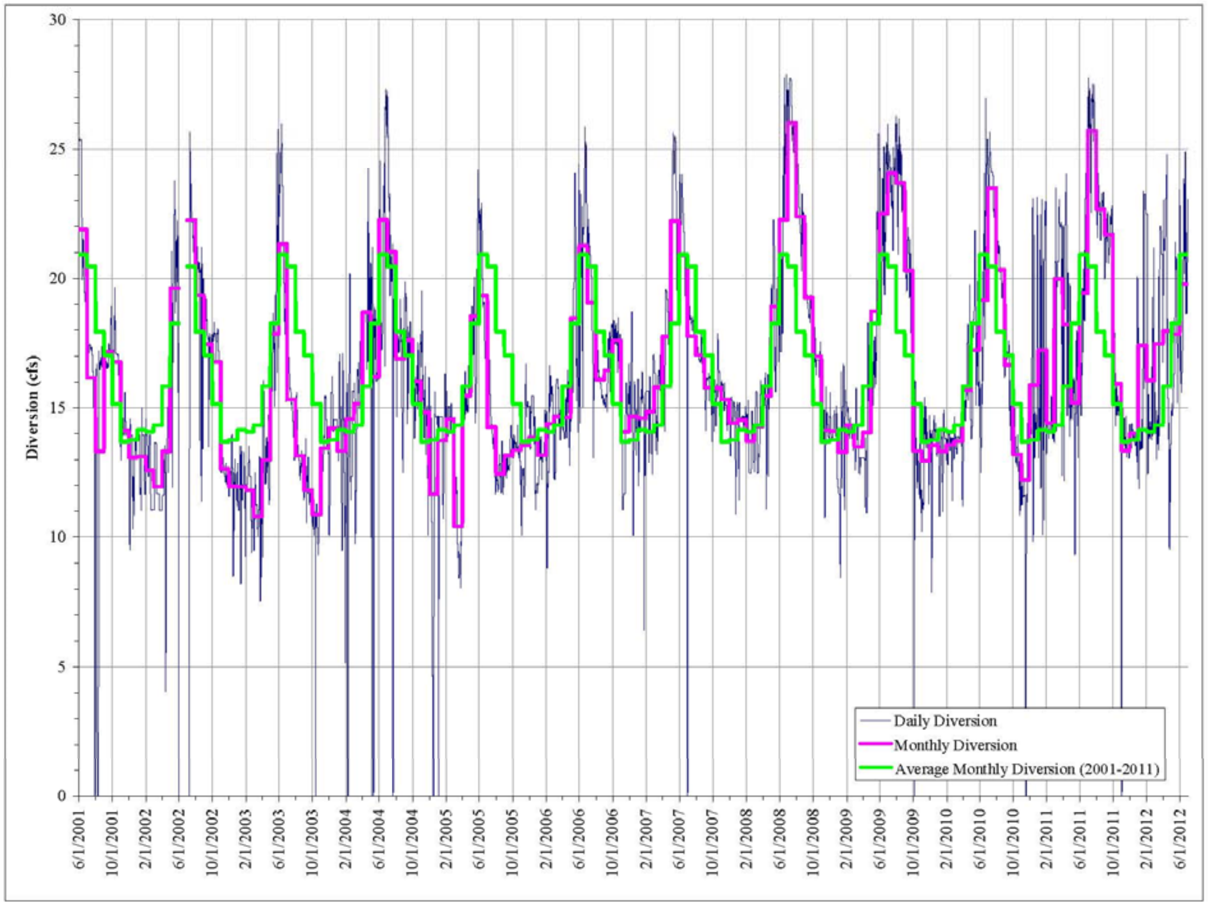


Figure 7. City of Walla Walla Diversions from Mill Creek (6/2001 - 6/2012)

Appendix D

Results of Instream Flow Studies and Flow Setting Methods in the Walla Walla River, Mill Creek, and Touchet River Basins

Table D-1. Stream flow and percent of weighted usable area by reach, species and life stage.

Reach	Priority species	Lifestage	80% of maximum WUA – ascending limb (cfs)	100% WUA (cfs)	80% of maximum WUA - descending limb (cfs)
Walla Walla Reach 5	Spring Chinook	CH Adult Migration / Holding	46	80	218
		CH Adult Spawning	46	80	218
		CH Juvenile / Fry rearing	140	325	325
	Bull trout	Adult migration	8	150	172
	Steelhead	SH Adult migration	65	150	325
		SH Spawning	65	150	325
		SH Juvenile / Fry rearing	90	325	325
Walla Walla Reach 4	Spring Chinook	CH Adult migration	102	150	220
		CH Juvenile / Fry rearing	32	80	220
	Bull trout	Adult migration	12	35	82
	Steelhead	SH Adult migration	107	175	265
		SH Spawning	107	175	265
		SH Juvenile / Fry rearing	60	150	400
Walla Walla Reach 3	Spring Chinook	CH Adult migration	68	110	179
		CH Juvenile / Fry rearing	190	350	350
	Bull Trout	BT Adult migration	12	21	80
	Steelhead	SH Adult migration	80	150	265
		SH Juvenile / Fry rearing	190	350	350

Reach	Priority species	Lifestage	80% of maximum WUA – ascending limb (cfs)	100% WUA (cfs)	80% of maximum WUA - descending limb (cfs)
Mill Creek Reach 5	Spring Chinook	CH Adult migration	61	100	200
		CH Spawning	61	100	200
		CH Juvenile rearing	25	60	142
	Bull trout	BT Adult migration	85	150	200
	Steelhead	SH Adult migration	75	150	200
		SH Spawning	75	150	200
		SH Juvenile/Fry rearing	85	200	-
		SH Fry rearing	26	40	175
Mill Creek Reach 4	Spring Chinook	CH Adult migration	61	100	200
		CH Spawning	61	100	200
		CH Juvenile rearing	25	60	142
	Bull trout	BT Adult migration	85	150	200
	Steelhead	SH Adult migration	75	150	200
		SH Spawning	75	150	200
		SH Juvenile/Fry rearing	85	200	-
		SH Fry rearing	26	40	175
Mill Creek Reach 1	Spring Chinook	CH Adult migration	36	56	80
		CH Juvenile/Fry rearing	15	30	120
	Bull trout	Adult migration	8	18	30
	Steelhead	SH Adult migration	38	60	100
		SH Juvenile/Fry rearing	20	40	130

Reach	Priority species	Lifestage	80% of maximum WUA – ascending limb (cfs)	100% WUA (cfs)	80% of maximum WUA - descending limb (cfs)
North Fork Touchet River	Bull trout	BT Adult migration / holding	81	122	197
		BT Spawning	25	60	200
	Steelhead	SH Adult migration	89	125	195
		SH Spawning	89	125	195
		SH Juvenile/Fry rearing	58	100	250
		SH Fry rearing	-	25	38
Touchet River Reach 2	Bull trout	BT Adult migration	130	225	300
	Steelhead	SH Adult migration	140	225	300
		SH Juvenile/Fry rearing	103	200	300
Coppei Creek	Steelhead	SH Adult migration	44	62	100
		SH Adult spawning	44	62	100
		SH Fry rearing	1	3	15
		SH Juvenile/Fry rearing	27	62	100

Table D-2. Walla Walla River basin 80% exceedance discharge calculated by reach; used in flow prescriptions.

Walla Walla River basin 80% exceedance discharge (cfs)													
Reach	**Years of analysis**	**October (cfs)**	**November (cfs)**	**December (cfs)**	**January (cfs)**	**February (cfs)**	**March (cfs)**	**April (cfs)**	**May (cfs)**	**June (cfs)**	**July (cfs)**	**August (cfs)**	**September (cfs)**
North Fork Walla Walla	1952–1968	6	9	11	17	27	32	33	71	11	3	2	3
South Fork Walla Walla	1952–1968	95	103	113	120	133	142	192	225	140	108	98	95
Walla Walla Reach 6	1952–1968	102	113	124	141	154	175	268	279	150	111	101	98
Walla Walla Reach 5	1952–1968	181	191	195	184	220	233	381	414	265	184	170	171
Walla Walla Reach 4	1952–1968	181	194	197	190	230	243	406	435	267	184	170	171
Walla Walla Reach 3	1952–1968	230	247	259	273	329	346	595	580	355	237	217	215
Walla Walla Reach 2	1952–1968	233	252	264	284	345	365	624	595	359	238	218	216
Walla Walla Reach 1	1952–1967	291	321	355	388	417	599	985	871	447	281	250	258
Mill Creek Reach 5	1940–1971	43	49	55	62	76	90	131	104	66	51	44	44
Mill Creek Reach 4	1940–1971	43	49	55	62	76	90	131	1104	66	51	44	44
Mill Creek Reach 3	1941–1952	44	51	58	68	87	104	149	110	67	51	45	45
Mill Creek Reach 2	1941–1952	44	51	58	68	87	104	149	110	67	51	45	45
Mill Creek Reach 1	1941–1952	44	51	58	68	87	104	149	110	67	51	45	45
North Fork Touchet	1951–1967	42	46	61	55	88	102	140	124	63	43	40	40
South Fork Touchet	1951–1967	2	3	5	7	14	19	21	9	3	1	1	1

Walla Walla River basin 80% exceedance discharge (cfs)													
Reach	**Years of analysis**	**October (cfs)**	**November (cfs)**	**December (cfs)**	**January (cfs)**	**February (cfs)**	**March (cfs)**	**April (cfs)**	**May (cfs)**	**June (cfs)**	**July (cfs)**	**August (cfs)**	**September (cfs)**
Touchet Reach2	1951–1967	45	60	78	96	153	196	219	148	60	35	25	32
Coppei Creek	1951–1967	2	3	4	6	12	16	17	8	3	1	1	1
Touchet Reach1	1951–1967	48	64	82	102	165	210	236	157	64	36	26	33

Table D-3. Modified Tennant Method flows for tributaries and reaches without PHABSIM studies.

Month	**Walla Walla River basin**							**Mill Creek basin**	**Touchet River basin**	
	North Fork Walla Walla River (cfs)	**South Fork Walla Walla River (cfs)**	**Walla Walla River Reach 6 (cfs)**	**Couse Creek (cfs)**	**Cottonwood Creek (cfs)**	**Dry Creek (cfs)**	**Pine Creek (cfs)**	**Blue Creek (cfs)**	**SF Touchet River (cfs)**	**Coppei Creek (cfs)**
October	11.1	70.0	88.0	0.7	1.3	4.0	0.7	2.6	3.0	3.7
November	21.2	70.0	88.0	5.0	8.6	8.8	4.0	6.2	5.6	7.0
December	21.5	70.0	90.9	5.5	9.4	10.9	5.7	8.5	6.0	7.1
January	27.5	70.0	95.2	7.0	12.2	16.6	9.9	12.5	7.2	14.2
February	30.1	73.8	111.1	8.6	14.9	19.4	11.0	13.3	12.4	14.1
March	37.9	85.0	104.3	10.6	18.2	18.9	10.9	13.5	13.2	16.4
April	52.1	111.2	157.7	15.5	25.3	17.1	10.6	12.5	13.6	15.7
May	43.3	121.9	155.2	11.8	17.2	9.8	4.6	6.2	7.2	7.0
June	21.2	82.0	90.2	5.4	8.9	8.8	3.1	6.2	5.6	7.0
July	10.7	70.0	88.0	1.0	1.5	2.8	0.4	1.4	1.8	0.8
August	6.3	70.0	88.0	0.3	0.4	1.5	0.1	0.8	1.1	0.5
September	7.0	70.0	88.0	0.3	0.4	2.1	0.1	1.1	1.6	0.8

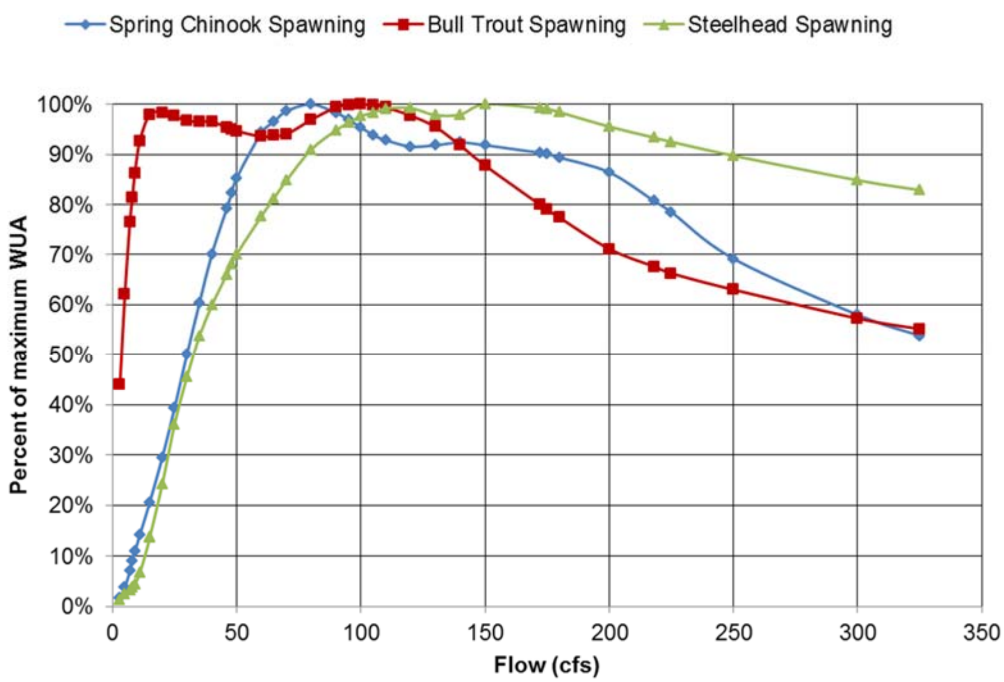


Figure D-1. Weighted usable area vs. flow for priority species spawning modeled in Walla Walla River Reach 5. Data are from Caldwell et al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

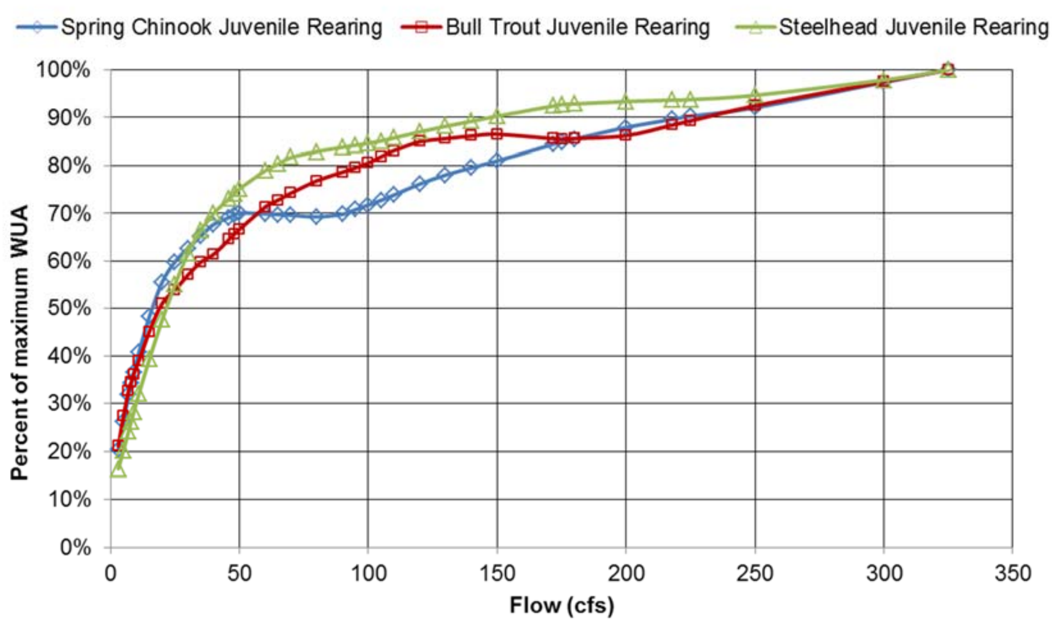


Figure D-2. Weighted usable area vs. flow for priority species rearing modeled in Walla Walla River Reach 5. Data are from Caldwell at al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

Table D-4. Percent of maximum weighted usable area vs. flow—Walla Walla River Reach 5.

Flow (cfs)	Spring Chinook spawning	Bull Trout spawning	Steelhead spawning	Spring Chinook Juvenile rearing	Bull Trout juvenile rearing	Steelhead Juvenile rearing
3	2%	44%	1%	20%	21%	16%
5	4%	62%	2%	26%	27%	20%
7	7%	77%	3%	32%	33%	24%
8	9%	81%	4%	34%	34%	26%
9	11%	86%	4%	37%	36%	28%
11	14%	93%	7%	41%	39%	32%
15	21%	98%	14%	48%	45%	39%
20	29%	98%	24%	56%	51%	48%
25	39%	98%	36%	60%	54%	55%
30	50%	97%	46%	63%	57%	62%
35	60%	97%	54%	65%	60%	66%
40	70%	97%	60%	68%	61%	70%
46	79%	95%	66%	69%	65%	73%
48	82%	95%	68%	70%	66%	74%
50	85%	95%	70%	70%	67%	75%
60	94%	94%	78%	70%	71%	79%
65	96%	94%	81%	70%	73%	80%
70	99%	94%	85%	70%	74%	82%
80	100%	97%	91%	69%	77%	83%
90	98%	99%	95%	70%	79%	84%
95	97%	100%	96%	71%	80%	84%
100	95%	100%	98%	72%	81%	85%
105	94%	100%	98%	73%	82%	85%
110	93%	99%	99%	74%	83%	86%
120	92%	98%	99%	76%	85%	87%
130	92%	95%	98%	78%	86%	88%
140	92%	92%	98%	80%	86%	89%
150	92%	88%	100%	81%	86%	90%
172	90%	80%	99%	84%	86%	92%
175	90%	79%	99%	85%	85%	93%
180	89%	77%	98%	85%	86%	93%
200	86%	71%	96%	88%	86%	93%
218	81%	68%	93%	90%	88%	94%
225	79%	66%	93%	90%	89%	94%

Flow (cfs)	Spring Chinook spawning	Bull Trout spawning	Steelhead spawning	Spring Chinook Juvenile rearing	Bull Trout juvenile rearing	Steelhead Juvenile rearing
250	69%	63%	90%	92%	92%	95%
300	58%	57%	85%	97%	98%	98%
325	54%	55%	83%	100%	100%	100%

2013 Walla Walla River below HWY 125 WUA from 15 to 325 cfs 3-flow. No stage/discharge.
Measured 5/24/2000; 6/22/2000; 6/27/2000; 6/12/2000 No 6/12 stage/discharge used. Recalibration May 16, 2013

Table D-5. Toe-width calculations—Yellowhawk Creek.

Priority species and lifestage	October	November	December	January	February	March	April	May	June	July	August	September
	SH[1] rearing	**SH rearing**	**SH rearing**	**SH rearing**	**SH Adult migration**	**SH adult migration**	**SH spawning**	**SH spawning**	**SH rearing**	**SH rearing**	**SH rearing**	**SH rearing**
Flow recommendation Preferred (cfs)	20.5	14.7	14.7	18.0	68.5	68.5	63.7	57.4	15.1	17.9	8.7	15.5
Flow recommendation Sustaining (cfs)	x	x	x	x	44.7	44.7	41.9	38.1	x	x	x	x

[1]Steelhead trout is priority species

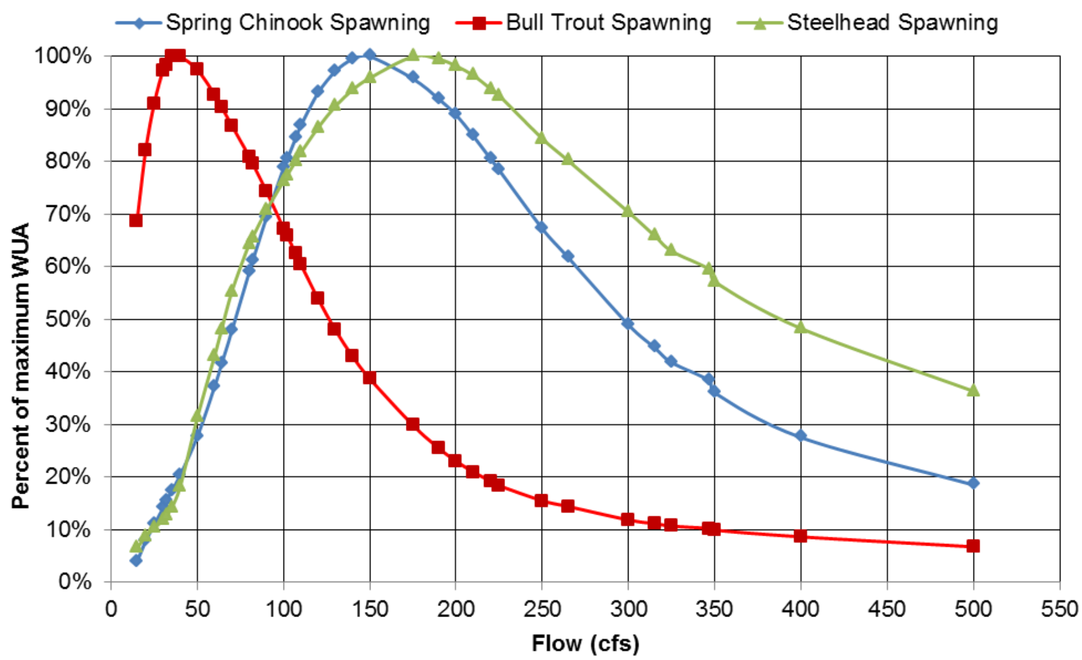


Figure D-3. Percent of maximum weighted usable area vs. flow for priority species spawning modeled in Walla Walla River Reach 4 below Yellowhawk Creek. Data are from Caldwell et al. 2003 and were recalibrated by WDFW (Beecher et al. 2013).

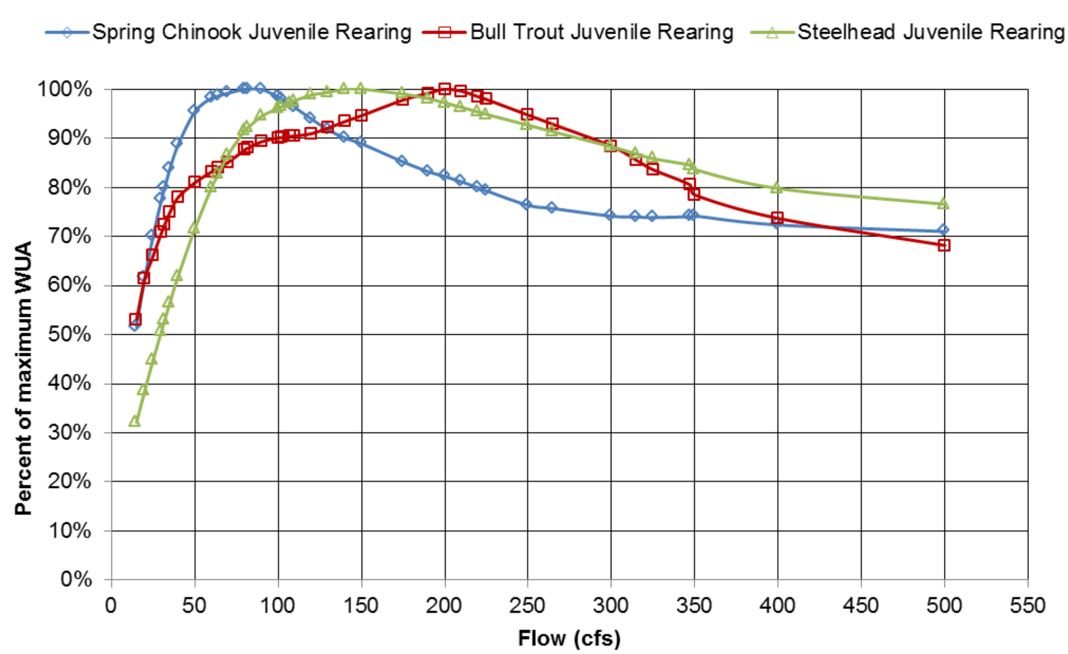


Figure D-4. Percent of maximum weighted usable area vs. flow for priority species rearing modeled in Walla Walla River Reach 4, below Yellowhawk Creek. Data are from Caldwell et al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

Table D-6. Percent of maximum weighted usable area vs. flow - Walla Walla Reach 4.

Flow (cfs)	Spring Chinook spawning	Bull trout spawning	Steelhead spawning	Spring Chinook juvenile rearing	Bull trout juvenile rearing	Steelhead juvenile rearing
15	4%	69%	7%	52%	53%	32%
20	8%	82%	9%	62%	61%	39%
25	11%	91%	10%	70%	66%	45%
30	14%	97%	12%	78%	71%	51%
32	15%	98%	13%	80%	72%	53%
35	17%	100%	14%	84%	75%	56%
40	20%	100%	18%	89%	78%	62%
50	28%	97%	31%	95%	81%	72%
60	37%	93%	43%	98%	83%	80%
64	41%	90%	48%	99%	84%	83%
70	48%	87%	55%	99%	85%	87%
80	59%	81%	64%	100%	88%	92%
82	61%	80%	66%	100%	88%	92%
90	69%	74%	71%	100%	89%	94%
100	79%	67%	76%	98%	90%	96%
102	80%	66%	77%	98%	90%	96%
107	84%	63%	80%	97%	90%	97%
110	87%	60%	82%	96%	90%	98%
120	93%	54%	86%	94%	91%	99%
130	97%	48%	91%	92%	92%	99%
140	100%	43%	94%	90%	93%	100%
150	100%	39%	96%	89%	95%	100%
175	96%	30%	100%	85%	98%	99%
190	92%	26%	99%	83%	99%	98%
200	89%	23%	98%	82%	100%	97%
210	85%	21%	96%	81%	100%	96%
220	81%	19%	94%	80%	98%	95%
225	78%	18%	93%	79%	98%	95%
250	67%	16%	84%	76%	95%	93%
265	62%	14%	80%	76%	93%	91%
300	49%	12%	70%	74%	88%	88%
315	45%	11%	66%	74%	86%	87%
325	42%	11%	63%	74%	84%	86%
347	38%	10%	60%	74%	81%	85%
350	36%	10%	57%	74%	78%	84%

Flow (cfs)	Spring Chinook spawning	Bull trout spawning	Steelhead spawning	Spring Chinook juvenile rearing	Bull trout juvenile rearing	Steelhead juvenile rearing
400	28%	9%	48%	72%	74%	80%
500	19%	7%	36%	71%	68%	77%

Walla Walla River at Cofeen Site measured 327 cfs on 6/12/00; 130 cfs on 6/21/00; 68 cfs on 6/28/00 and 46 cfs 7/12/00. Recalibrated by J. Kohr MAY 16, 2013 - 3:31 p.m.

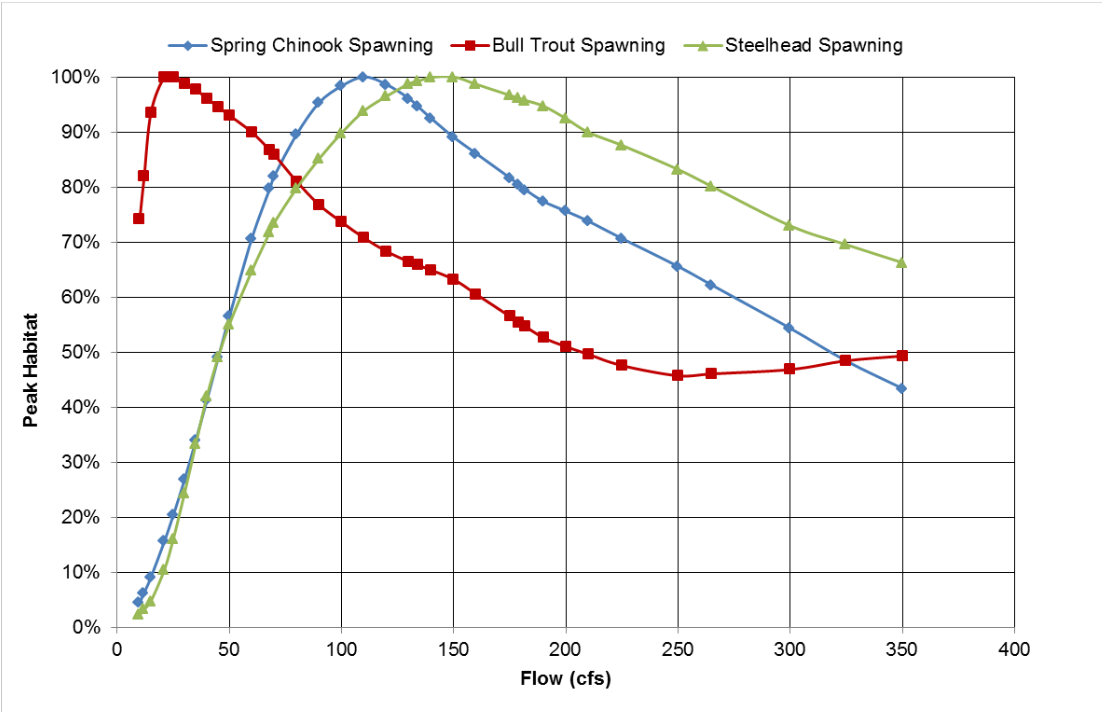


Figure D-5. Percent of maximum weighted usable area vs. flow for priority species spawning Walla Walla River Reach 3, below Mill Creek. Data are from Caldwell et al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

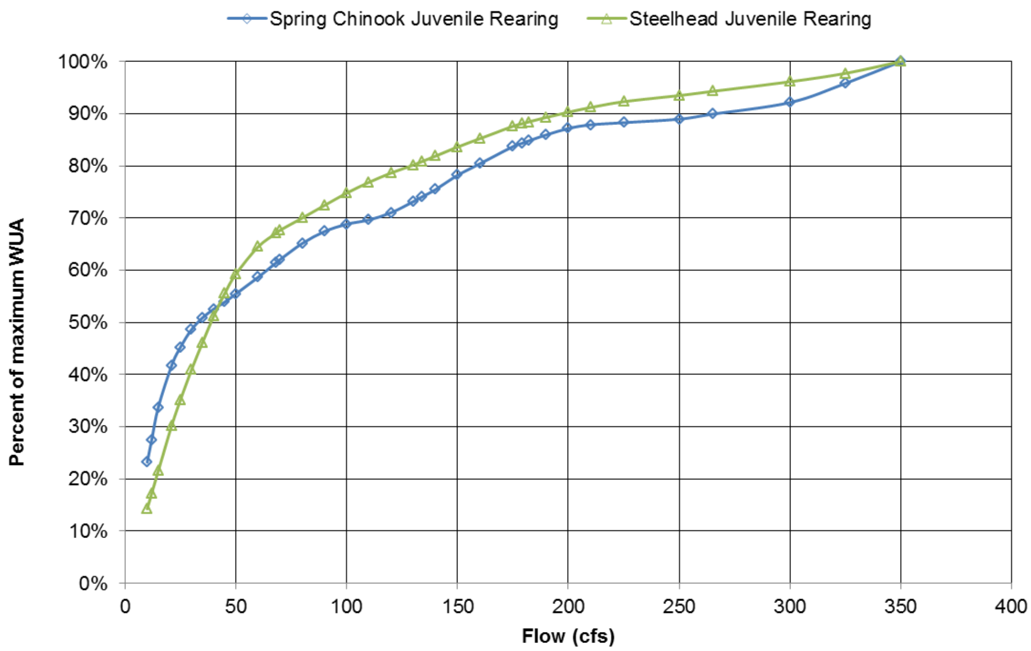


Figure D-6. Percent of maximum weighted usable area vs. flow for priority species rearing in Walla Walla River Reach 3, below Mill Creek. Data are from Caldwell et al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

Table D-7. Percent of maximum weighted usable area vs. flow—Walla Walla Reach 3.

Flow (cfs)	Spring Chinook spawning	Bull trout spawning	Steelhead spawning	Spring Chinook juvenile rearing	Bull trout juvenile rearing	Steelhead juvenile rearing
10	4%	74%	2%	23%	21%	14%
12	6%	82%	3%	27%	23%	17%
15	9%	94%	5%	34%	27%	22%
21	16%	100%	10%	42%	30%	30%
25	20%	100%	16%	45%	31%	35%
30	27%	99%	24%	49%	33%	41%
35	34%	98%	33%	51%	35%	46%
40	41%	96%	42%	53%	38%	51%
45	49%	95%	49%	54%	41%	56%
50	56%	93%	55%	55%	43%	59%
60	71%	90%	65%	59%	48%	64%
68	80%	87%	72%	61%	51%	67%
70	82%	86%	74%	62%	52%	68%
80	90%	81%	80%	65%	60%	70%

Flow (cfs)	Spring Chinook spawning	Bull trout spawning	Steelhead spawning	Spring Chinook juvenile rearing	Bull trout juvenile rearing	Steelhead juvenile rearing
90	95%	77%	85%	67%	66%	72%
100	98%	74%	90%	69%	70%	75%
110	100%	71%	94%	70%	76%	77%
120	99%	68%	96%	71%	80%	79%
130	96%	66%	99%	73%	82%	80%
134	95%	66%	99%	74%	83%	81%
140	92%	65%	100%	75%	85%	82%
150	89%	63%	100%	78%	87%	84%
160	86%	61%	99%	80%	87%	85%
175	82%	56%	97%	84%	88%	88%
179	80%	55%	96%	84%	87%	88%
182	79%	55%	96%	85%	87%	88%
190	77%	53%	95%	86%	87%	89%
200	76%	51%	92%	87%	87%	90%
210	74%	50%	90%	88%	87%	91%
225	71%	48%	88%	88%	87%	92%
250	66%	46%	83%	89%	91%	93%
265	62%	46%	80%	90%	92%	94%
300	54%	47%	73%	92%	94%	96%
325	48%	48%	70%	96%	96%	98%
350	43%	49%	66%	100%	100%	100%

Walla Walla River below Mill Creek,Recalibrated effort by J.Kohr May 16, 2013 measured June 4, 1999 - 180 cfs; June 11 - 70 cfs; July 7 - 21 cfs

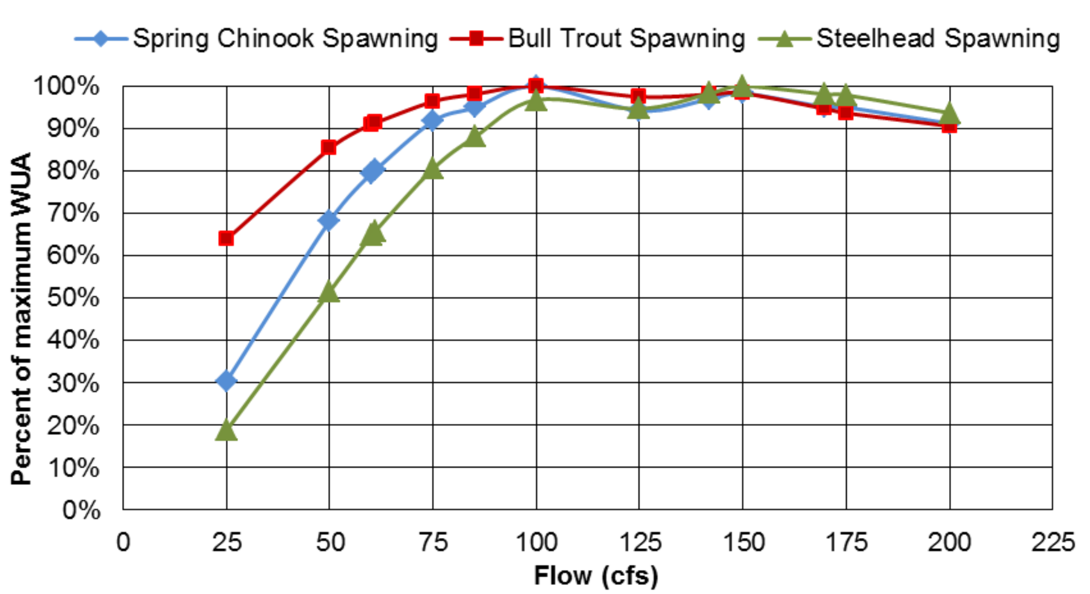


Figure D-7. Percent of maximum weighted usable area vs. flow for priority species spawning in upper Mill Creek Reach 4. Data are from Barber et al. 2003.

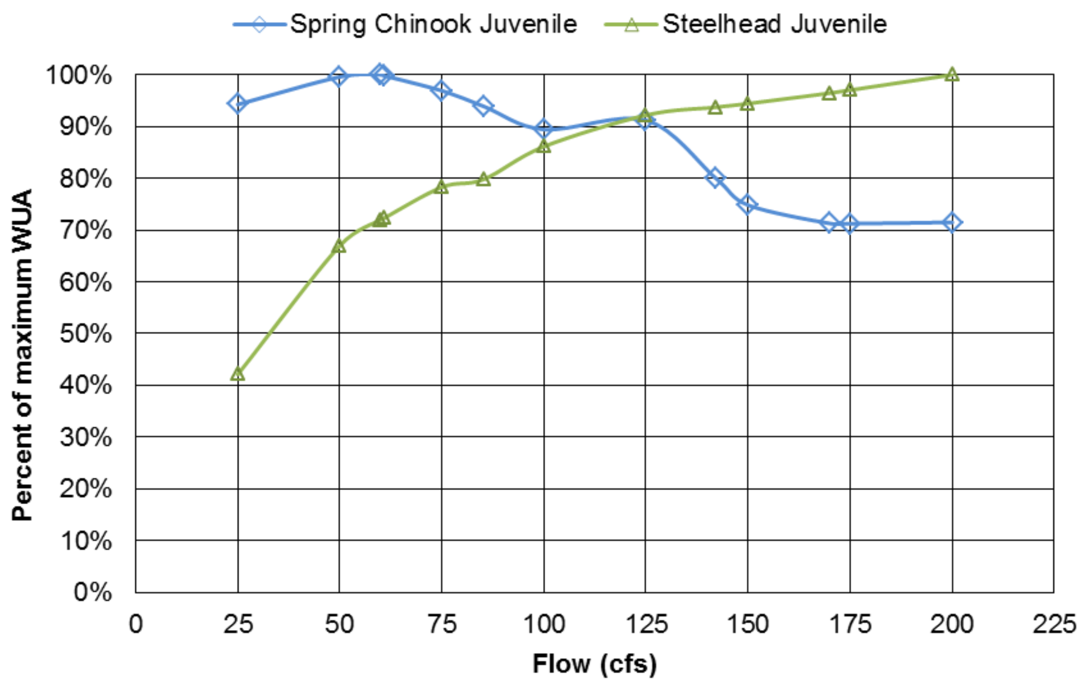


Figure D-8. Percent of maximum weighted usable area vs. flow for priority species rearing in upper Mill Creek Reach 4. Data are from Barber et al. 2003.

Table D-8. Percent of maximum weighted usable area vs. flow—Mill Creek Reach 4.

Flow (cfs)	Spring Chinook Spawning	Bull Trout Spawning	Bull Trout Adult Migration	Steelhead Spawning	Spring Chinook Juvenile	Steelhead Juvenile
25	30%	64%	32%	19%	94%	42%
50	68%	85%	58%	52%	100%	67%
60	79%	91%	68%	65%	100%	72%
61	80%	91%	68%	66%	100%	72%
75	92%	96%	78%	81%	97%	78%
85	95%	98%	81%	88%	94%	80%
100	100%	**100%**	87%	97%	89%	86%
125	94%	98%	91%	95%	91%	92%
142	97%	98%	97%	98%	80%	94%
150	98%	98%	**100%**	**100%**	75%	94%
170	95%	95%	98%	98%	71%	96%
175	95%	94%	98%	98%	71%	97%
200	91%	91%	97%	94%	71%	**100%**

*Data from Table 15. Barber et al. 2003

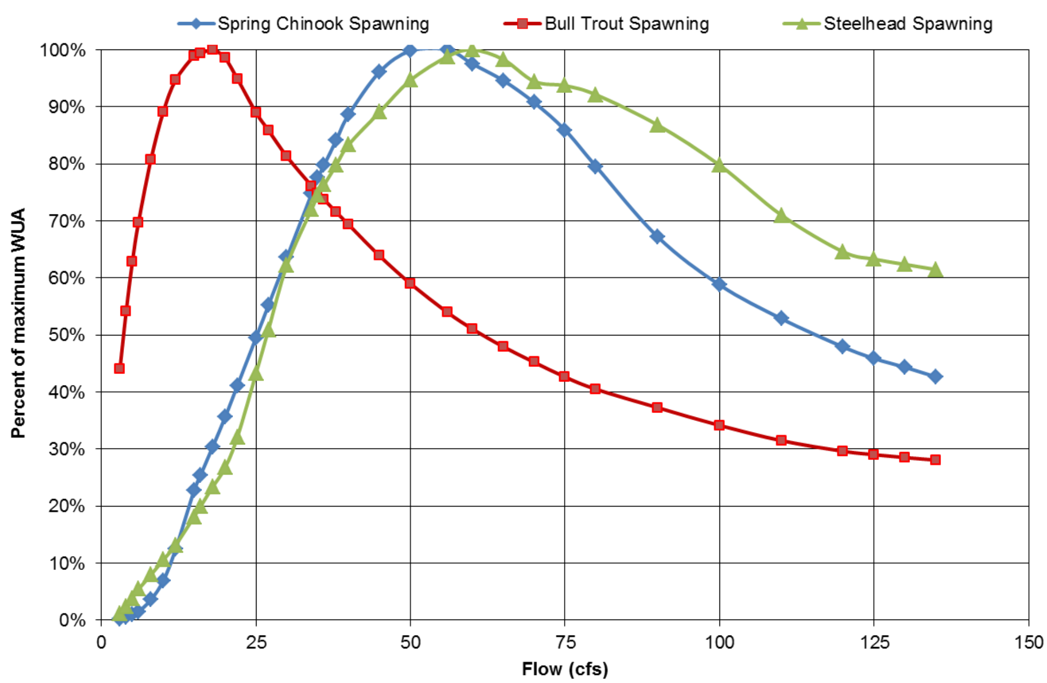


Figure D-9. Percent of maximum weighted usable area vs. flow for priority species spawning in Mill Creek Reach 1. Data from Caldwell et al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

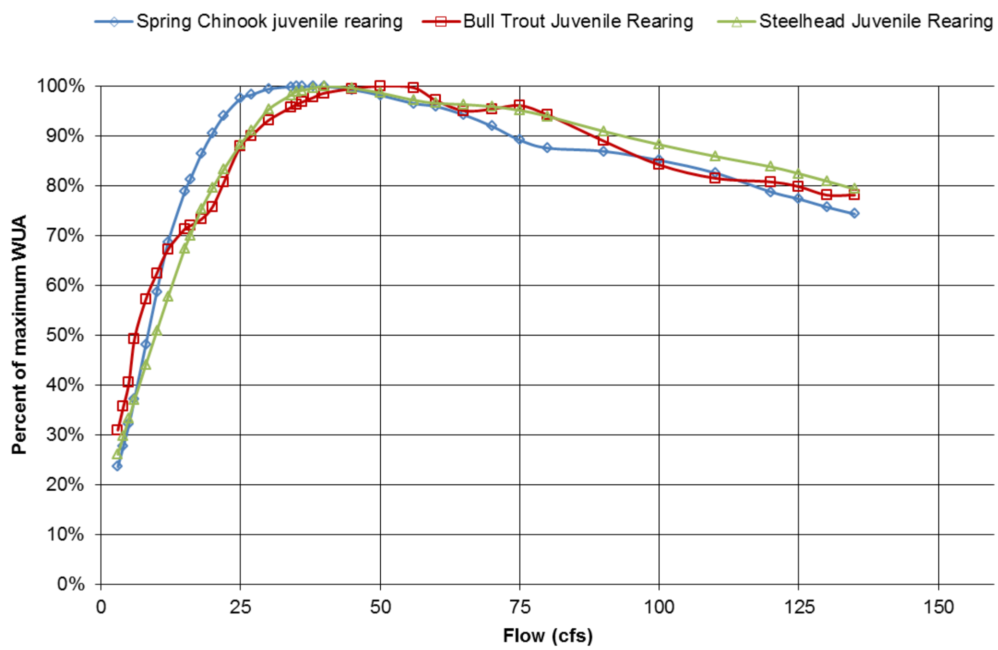


Figure D-10. Percent of maximum weighted usable area vs. flow for priority species rearing in Mill Creek Reach 1. Data from Caldwell et al. 2002 and were recalibrated by WDFW (Beecher et al. 2013).

Table D-9. Percent of maximum weighted usable area vs. flow—Mill Creek Reach 1.

Flow (cfs)	Spring Chinook spawning	Bull trout spawning	Steelhead spawning	Spring Chinook juvenile rearing	Bull trout juvenile rearing	Steelhead juvenile rearing
3	0%	44%	1%	24%	31%	26%
4	1%	54%	2%	28%	36%	30%
5	1%	63%	4%	32%	41%	33%
6	2%	70%	5%	37%	49%	37%
8	4%	81%	8%	48%	57%	44%
10	7%	89%	11%	59%	62%	51%
12	12%	95%	13%	69%	67%	58%
15	23%	99%	18%	79%	71%	67%
16	25%	99%	20%	81%	72%	70%
18	30%	100%	23%	86%	73%	75%
20	36%	99%	27%	91%	76%	80%
22	41%	95%	32%	94%	81%	83%
25	50%	89%	43%	98%	88%	88%
27	55%	86%	51%	98%	90%	91%

Flow (cfs)	Spring Chinook spawning	Bull trout spawning	Steelhead spawning	Spring Chinook juvenile rearing	Bull trout juvenile rearing	Steelhead juvenile rearing
30	64%	81%	62%	99%	93%	95%
34	75%	76%	72%	100%	96%	98%
35	78%	75%	75%	100%	96%	99%
36	80%	74%	76%	100%	97%	99%
38	84%	72%	80%	100%	98%	100%
40	89%	69%	83%	100%	99%	100%
45	96%	64%	89%	99%	100%	100%
50	100%	59%	95%	98%	100%	99%
56	100%	54%	99%	97%	100%	97%
60	98%	51%	100%	96%	97%	97%
65	95%	48%	98%	94%	95%	96%
70	91%	45%	94%	92%	95%	96%
75	86%	43%	94%	89%	96%	95%
80	80%	40%	92%	88%	94%	94%
90	67%	37%	87%	87%	89%	91%
100	59%	34%	80%	85%	84%	88%
110	53%	31%	71%	83%	82%	86%
120	48%	30%	65%	79%	81%	84%
125	46%	29%	63%	77%	80%	82%
130	44%	29%	62%	76%	78%	81%
135	43%	28%	61%	74%	78%	79%

* Data from Mill Cr at Wallula Rd (upstream), trib Walla Walla R, 1999, 61, 25, 5 cfs.
Beecher Caldwell, Shedd, Bauersfeld - WDFW, WDOE recalibrated 10/12 by J. Kohr. May 16, 2013

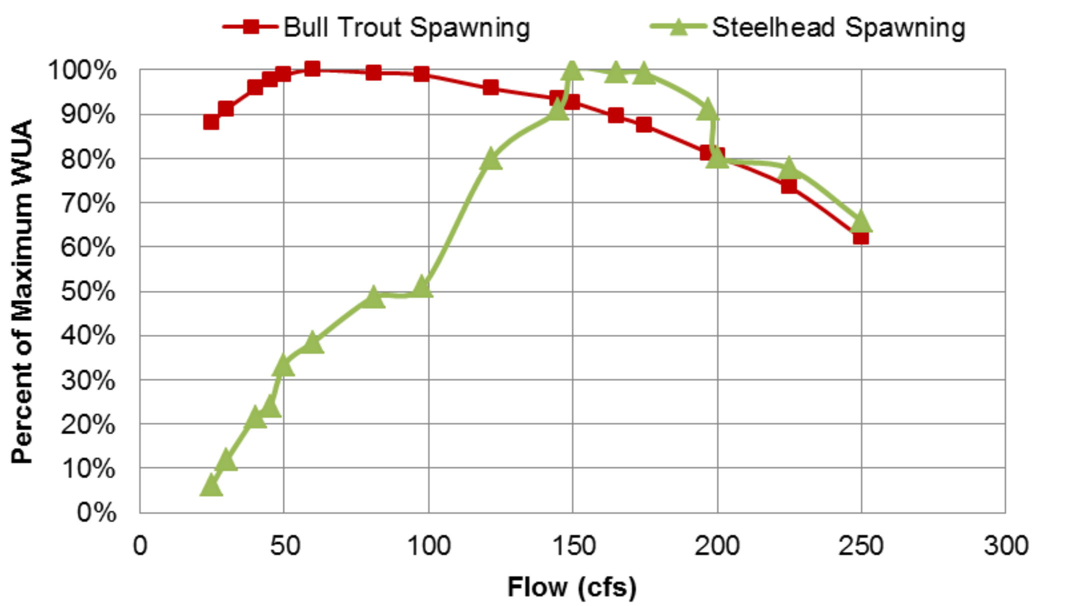


Figure D-11. Percent of maximum weighted usable area vs. flow for priority species spawning - North Fork Touchet River. Data digitized from graphics in Barber et al. 2001.

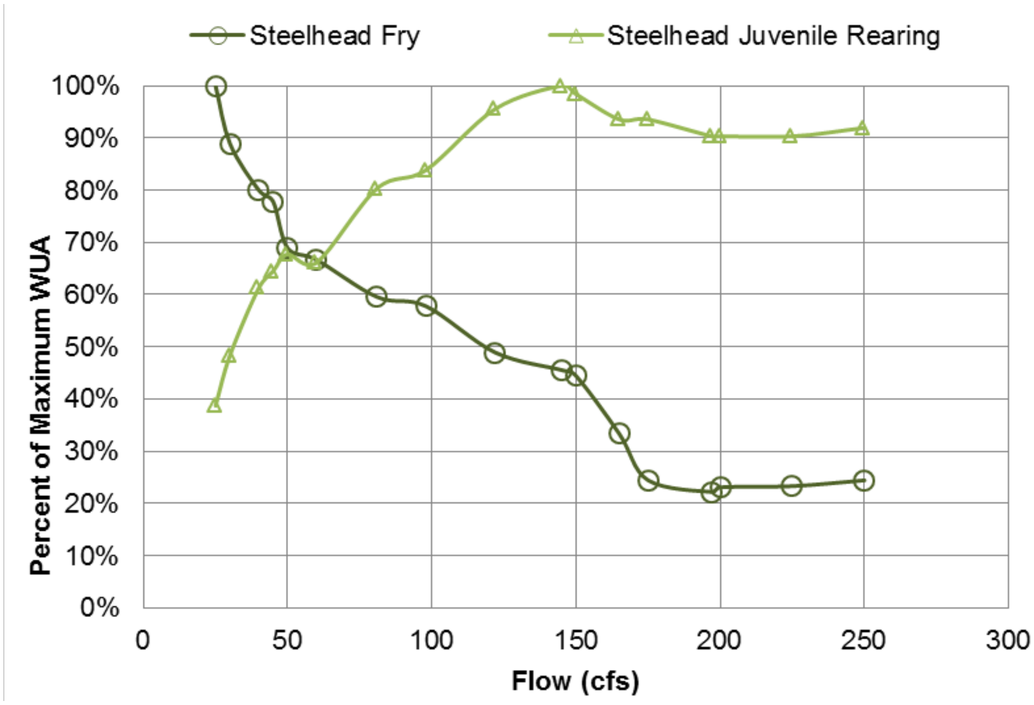


Figure D-12. Percent of maximum weighted usable area vs. flow for priority species rearing—North Fork Touchet River. Data digitized from graphics in Barber et al. 2001.

Table D-10. Percent of maximum weighted usable area vs. flow—North Fork Touchet River.

Flow	Bull Trout Spawning	Bull Trout Adult Migration	Steelhead Spawning	Steelhead Fry	Steelhead Juvenile Rearing
25	88%	23%	6%	100%	39%
30	91%	29%	12%	89%	48%
40	96%	40%	22%	80%	61%
45	98%	48%	24%	78%	65%
50	99%	51%	33%	69%	68%
60	100%	64%	39%	67%	66%
81	99%	80%	49%	60%	80%
98	99%	94%	51%	58%	84%
122	96%	100%	80%	49%	96%
145	93%	97%	91%	46%	100%
150	93%	97%	100%	44%	98%
165	90%	92%	99%	33%	94%
175	87%	89%	99%	24%	94%
197	81%	80%	91%	22%	90%
200	80%	79%	80%	23%	90%
225	74%	72%	78%	23%	90%
250	62%	63%	66%	24%	92%

Data points approximated from Barber et al. 2001 figures

Figure D-13. Percent of maximum weighted usable area vs. flow for priority species spawning – Touchet River Reach 2. Data digitized from graphics in Barber et al. 2001.

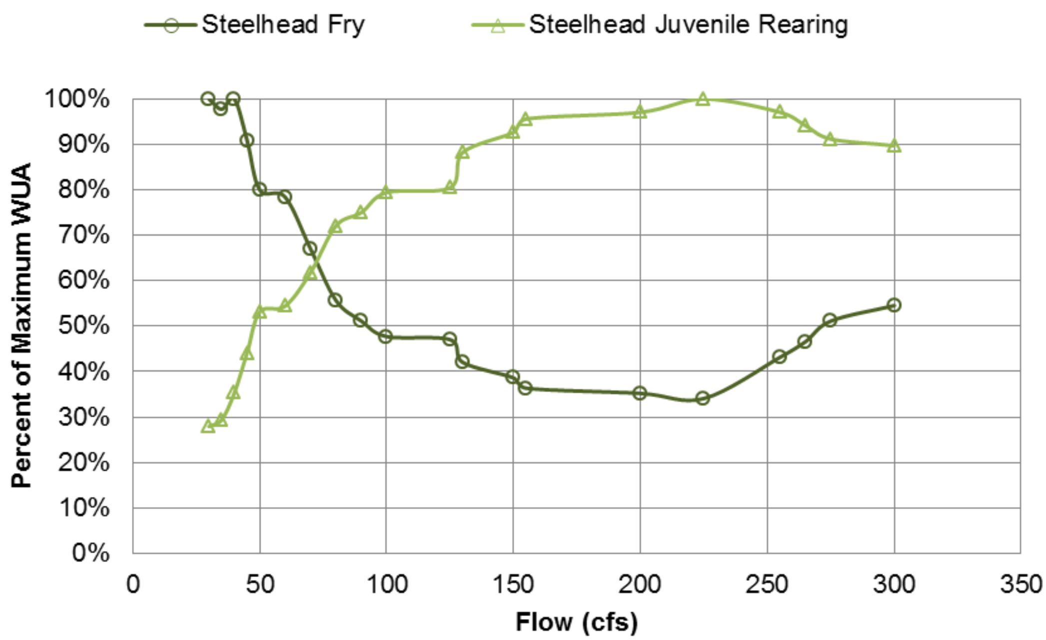


Figure D-14. Percent of maximum weighted usable area vs. flow for priority species rearing – Touchet River Reach 2. Data digitized from graphics in Barber et al. 2001.

Table D-11. Percent of maximum weighted usable area vs. flow—Touchet River Reach 2.

Flow	Bull trout spawning	Bull trout adult migration	Steelhead spawning	Steelhead fry	Steelhead juvenile rearing
30	75%	24%	15%	100%	28%
35	79%	26%	18%	98%	29%
40	82%	31%	22%	100%	35%
45	86%	40%	27%	91%	44%
50	88%	41%	32%	80%	53%
60	94%	49%	32%	78%	54%
70	98%	53%	37%	67%	62%
80	99%	58%	43%	56%	72%
90	100%	63%	49%	51%	75%
100	100%	72%	55%	48%	79%
125	99%	78%	56%	47%	80%
130	99%	80%	70%	42%	88%
150	97%	89%	80%	39%	93%
155	95%	91%	86%	36%	96%
200	90%	100%	90%	35%	97%
225	87%	100%	100%	34%	100%

Flow	Bull trout spawning	Bull trout adult migration	Steelhead spawning	Steelhead fry	Steelhead juvenile rearing
255	83%	99%	100%	43%	97%
265	80%	97%	97%	47%	94%
275	77%	94%	90%	51%	91%
300	72%	93%	84%	55%	90%

Data points approximated from Barber et al. 2001 figures

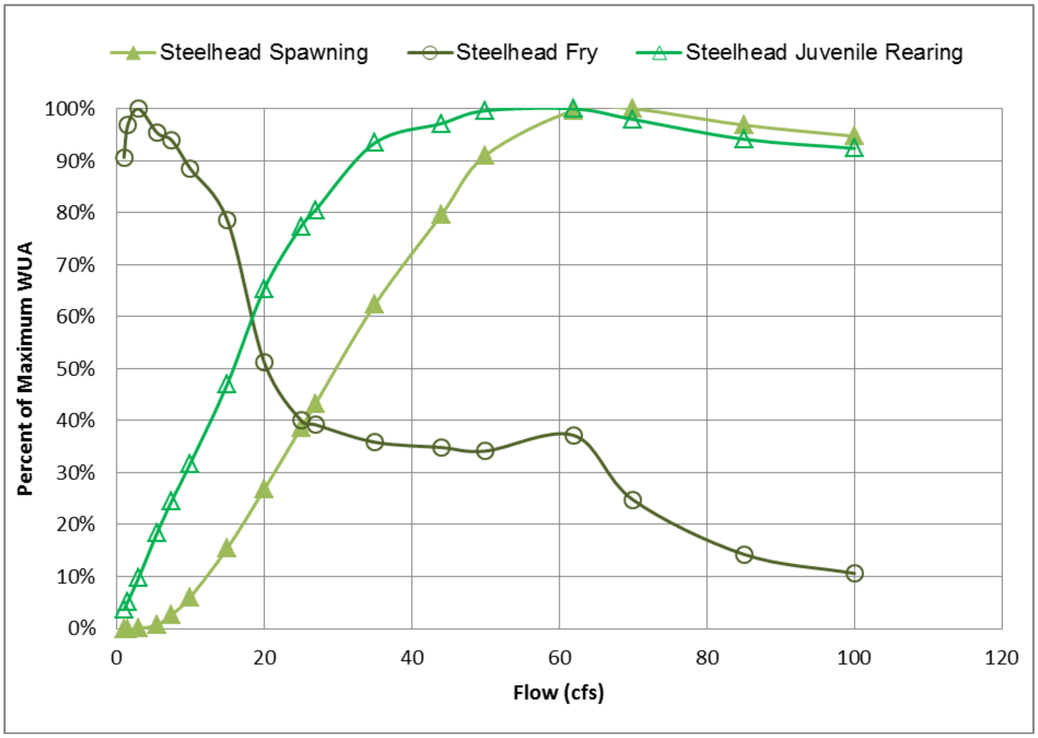


Figure D-15. Percent of maximum weighted usable area vs. flow for priority species spawning and rearing on Coppei Creek. Data digitized from graphics in Barber et al. 2003.

Table D-12. Percent of maximum weighted usable area vs. flow—Coppei Creek.

Flow (cfs)	Steelhead Spawning	Steelhead Fry	Steelhead Juvenile Rearing
1	0%	91%	4%
1.5	0%	97%	5%
3	0%	**100%**	10%
5.5	1%	95%	18%
7.5	3%	94%	25%
10	6%	88%	32%
15	15%	79%	47%
20	27%	51%	65%
25	39%	40%	77%
27	43%	39%	81%
35	62%	36%	93%
44	80%	35%	97%
50	91%	34%	**100%**
62	**100%**	37%	**100%**
70	**100%**	25%	98%
85	97%	14%	94%
100	95%	11%	92%

Data from Table C1-5. Barber et al. 2003 IFIM Mill Creek

Appendix E

Temperature Profiles by Reach in the Walla Walla River, Mill Creek, and Touchet River Basins

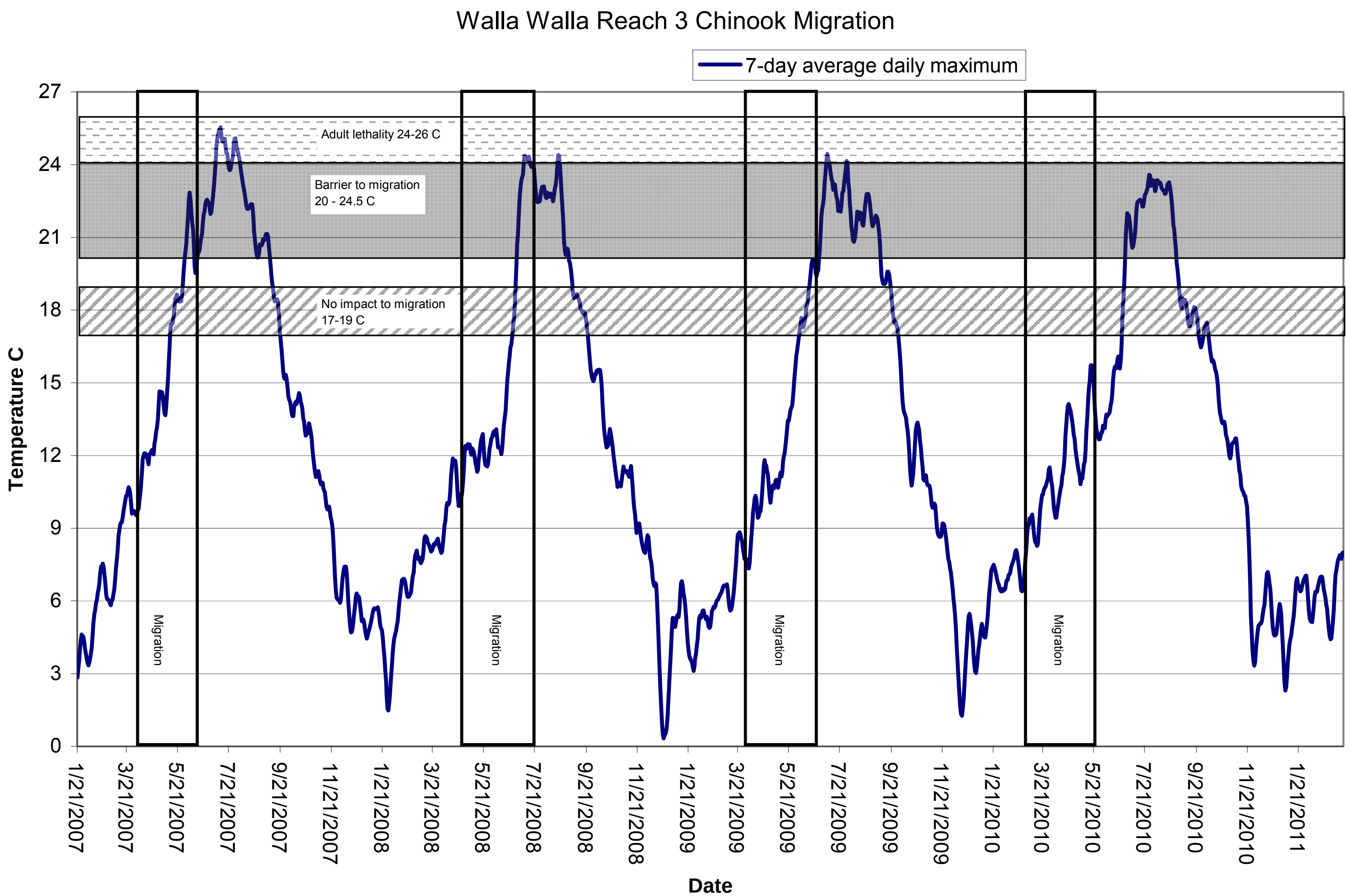


Figure E-1. Temperature profile in Walla Walla River Reach 3 during spring Chinook migration (April-June) for years 2007-2010. Data from WDOE gage #32A100.

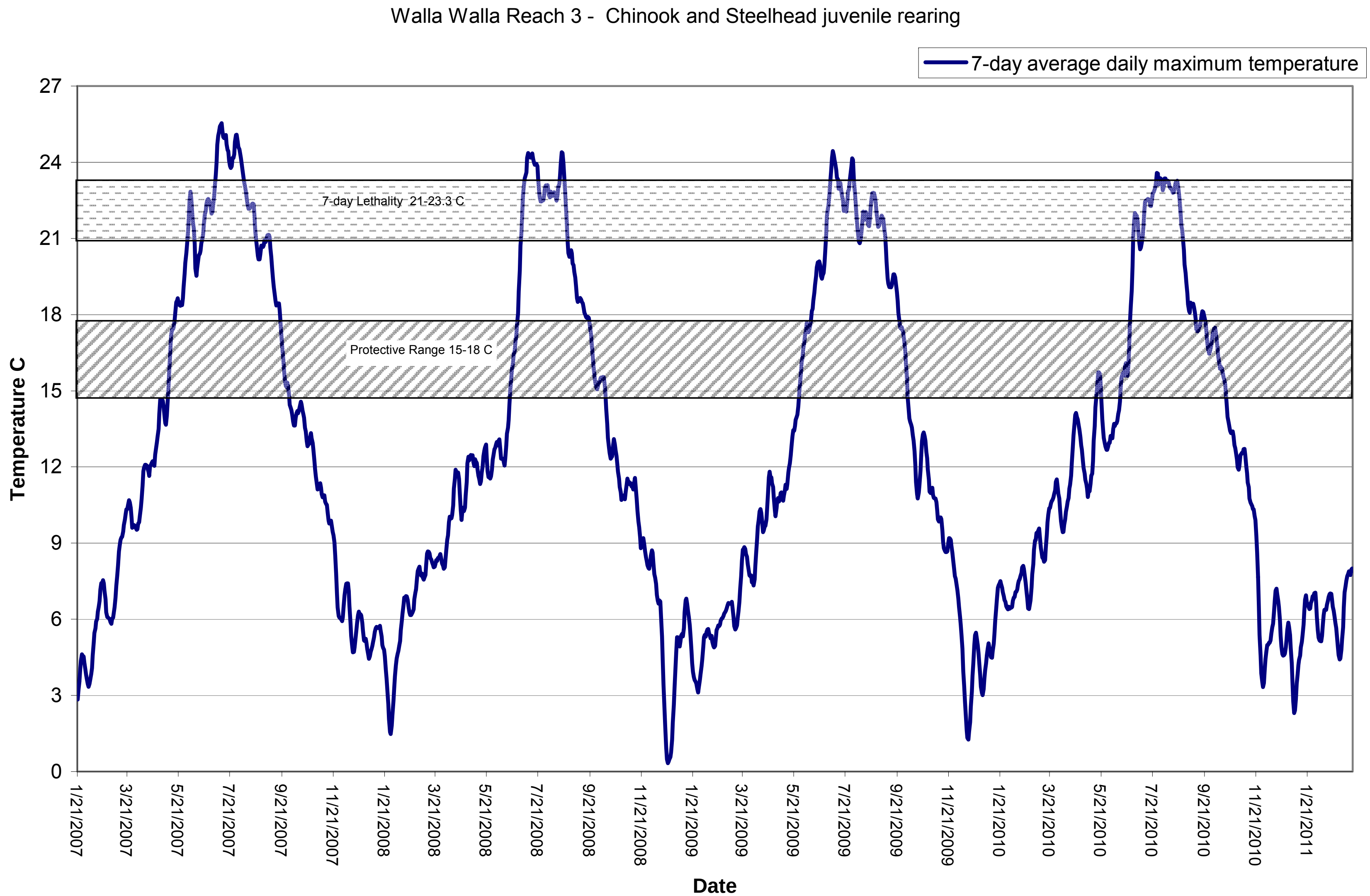


Figure E-2. Temperature profile. Juvenile Chinook and steelhead rearing in Walla Walla River Reach 3. Data from WDOE gage #32A100.

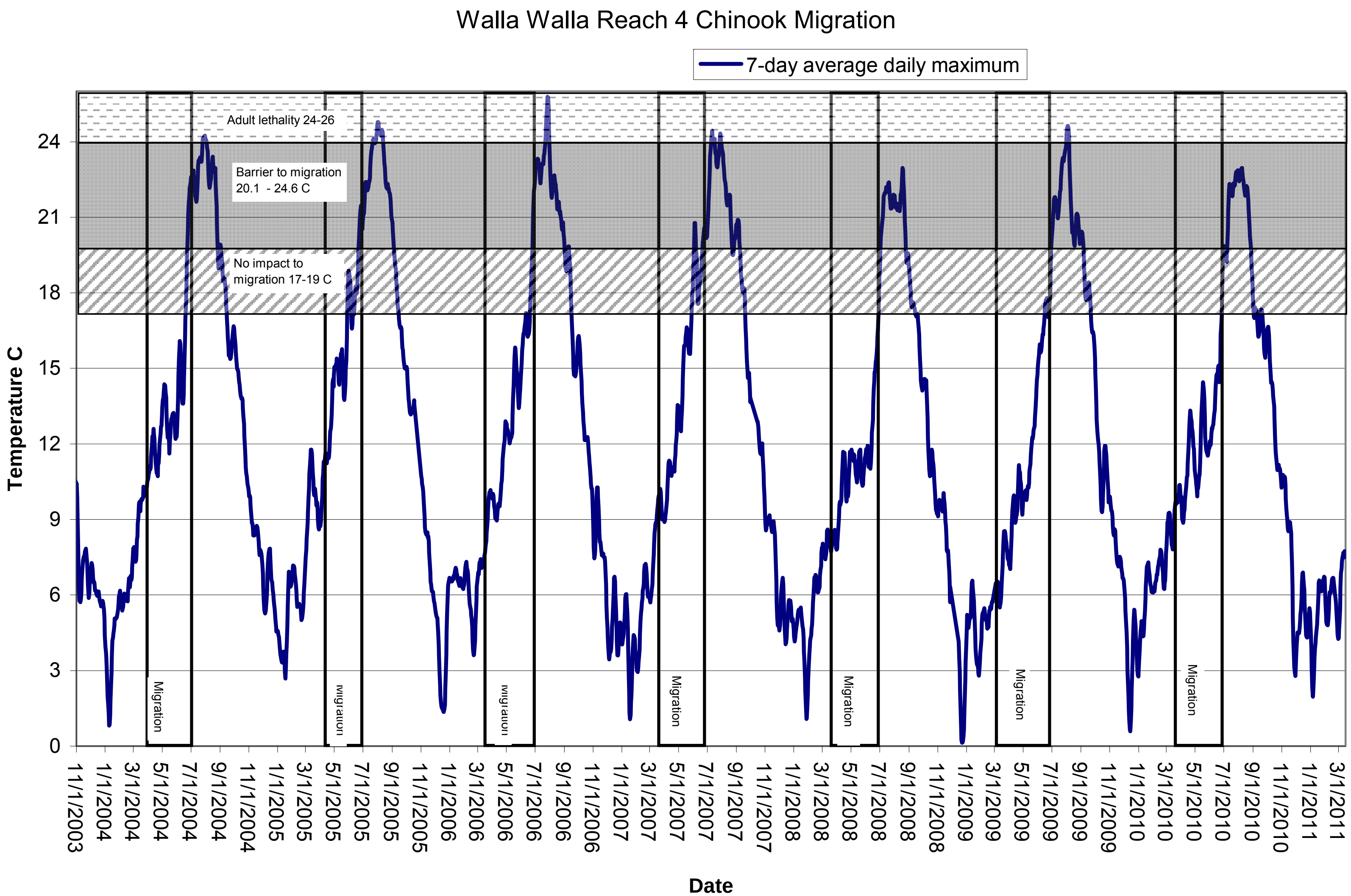


Figure E-3. Temperature profile. Chinook migration in Walla Walla River Reach 4. Data from WDOE gage #32A105.

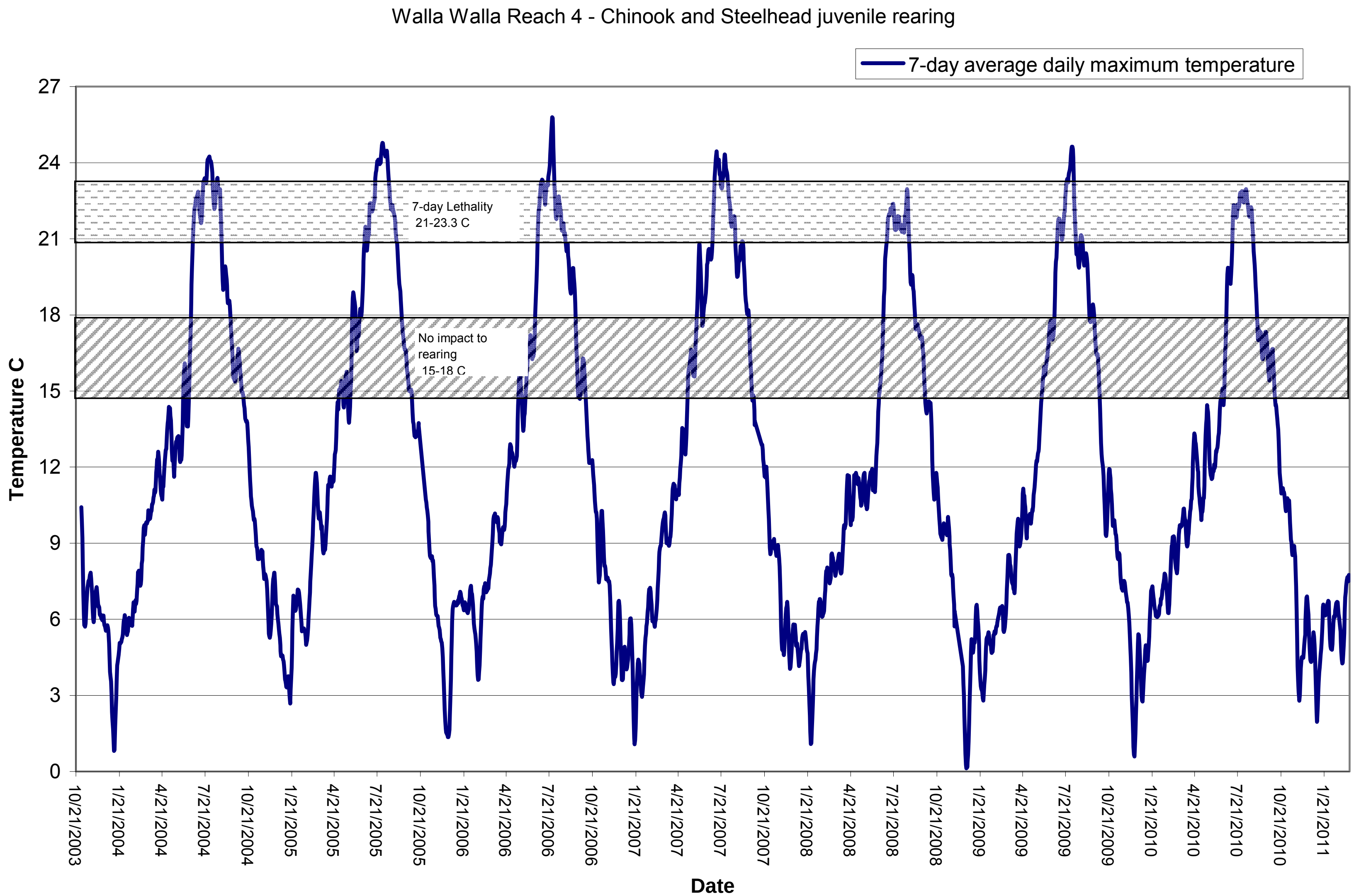


Figure E-4. Temperature profile. Juvenile Chinook and steelhead rearing in Walla Walla River Reach 4. Data from WDOE gage #32A105.

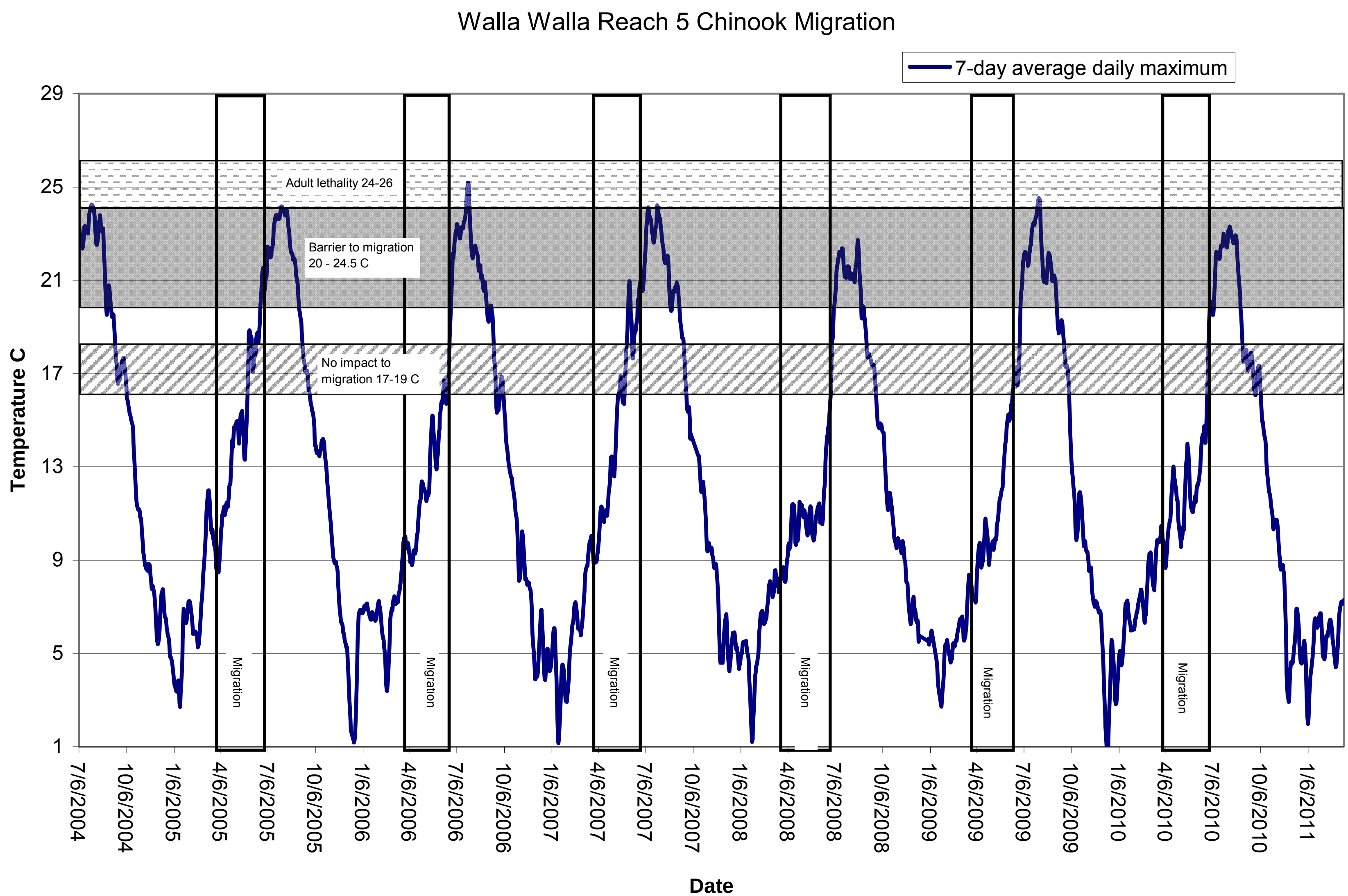


Figure E-5. Temperature profile. Chinook migration in Walla Walla River Reach 5. Data from WDOE gage # 32A120.

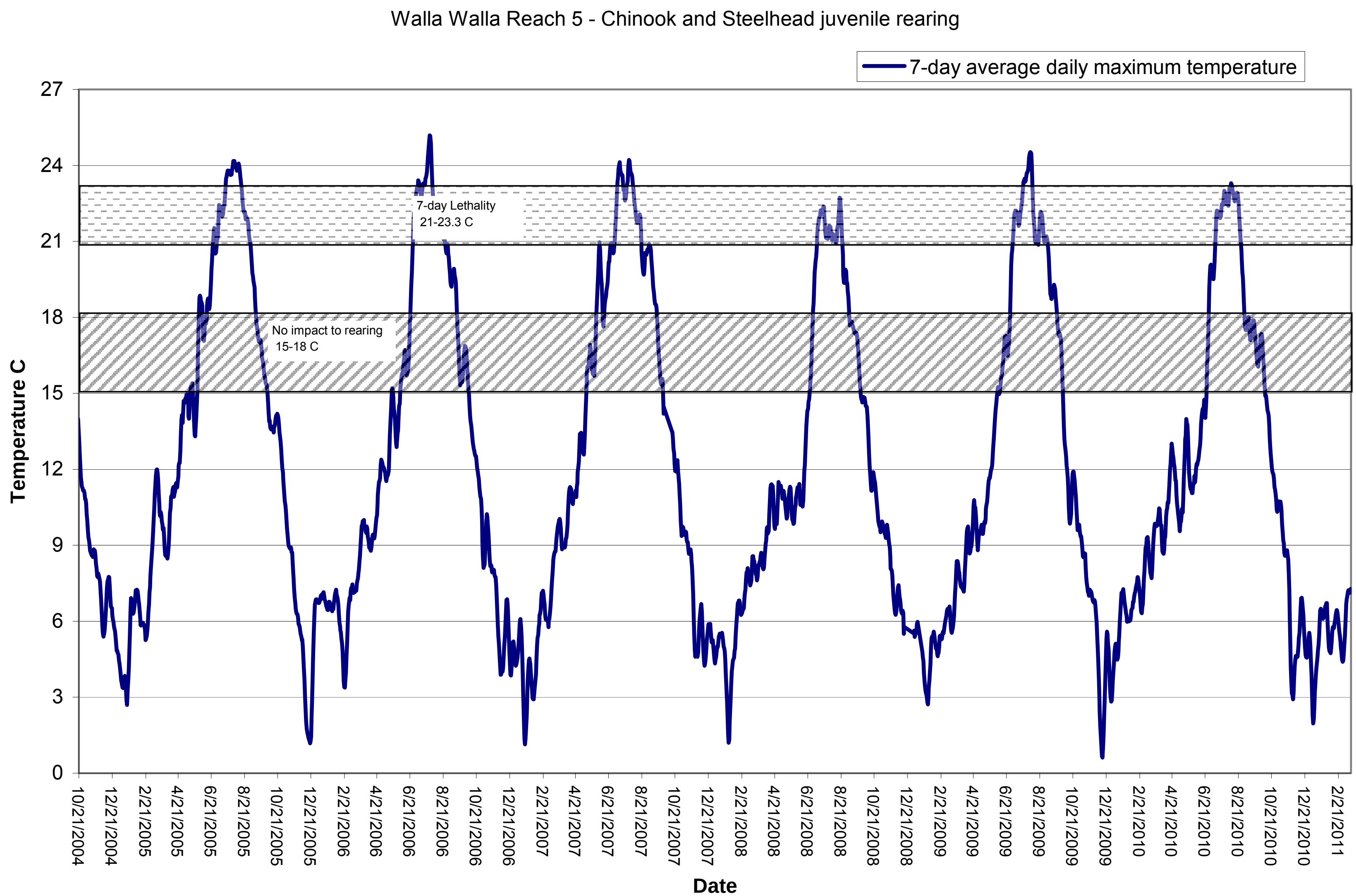


Figure E-6. Temperature profile. Juvenile Chinook and steelhead rearing in Walla Walla River Reach 5. Data from WDOE gage #32A120.

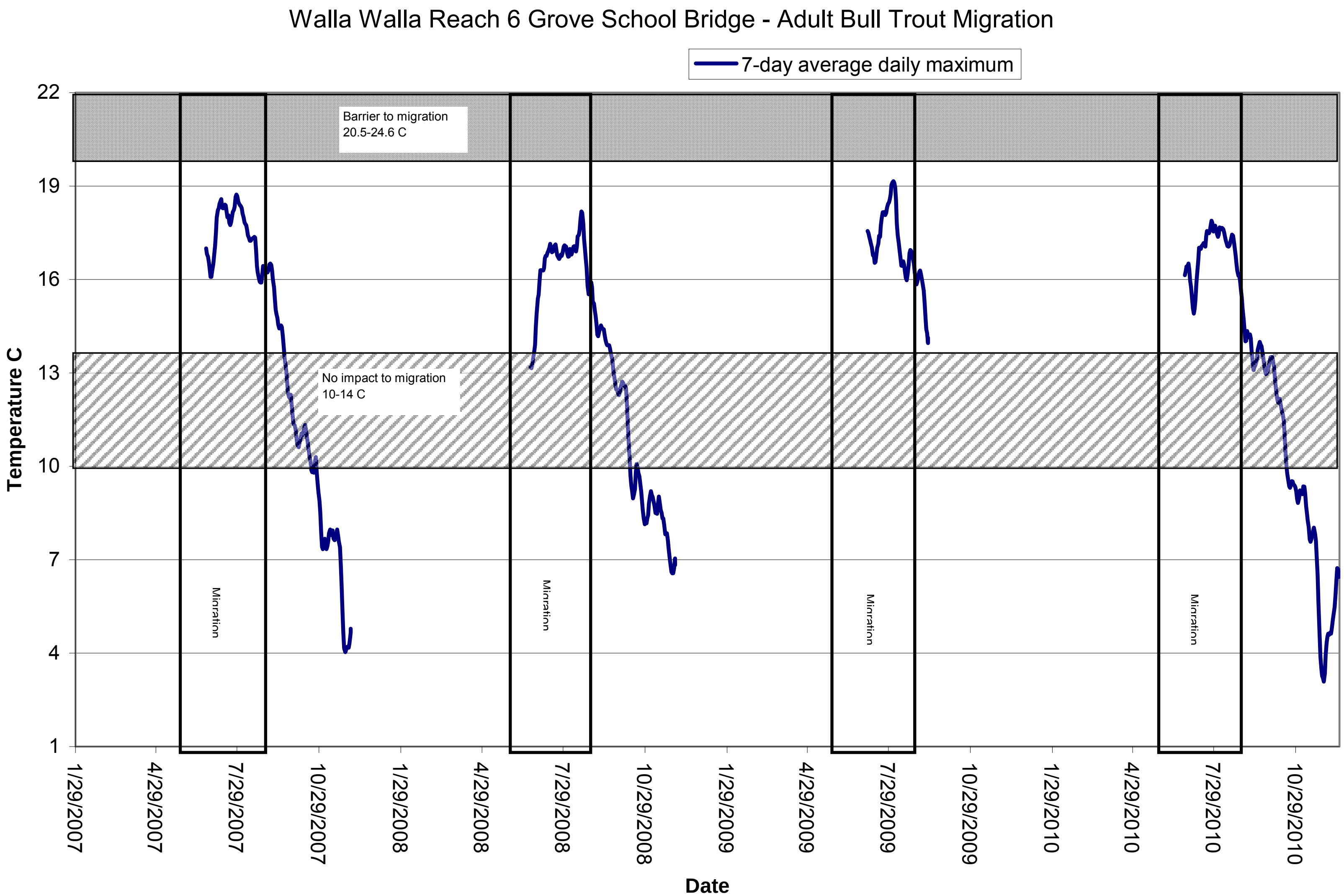


Figure E-7. Temperature profile. Adult bull trout migration in Walla Walla River Reach 6. Data from WWBWC gage #S105.

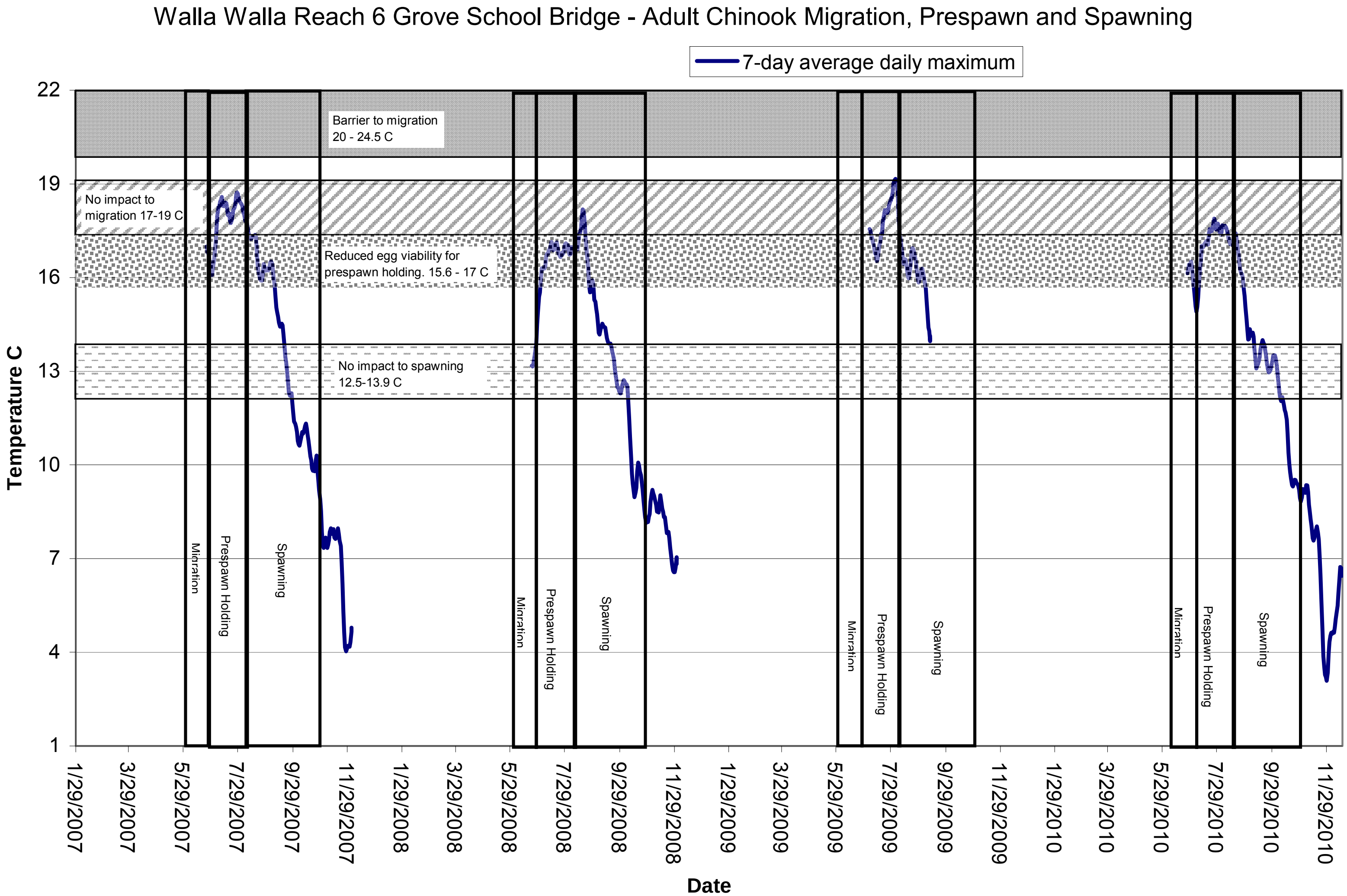


Figure E-8. Temperature profile. Chinook migration, pre-spawn holding and spawning Walla Walla River Reach 6. Data from WWBWC gage #S105.

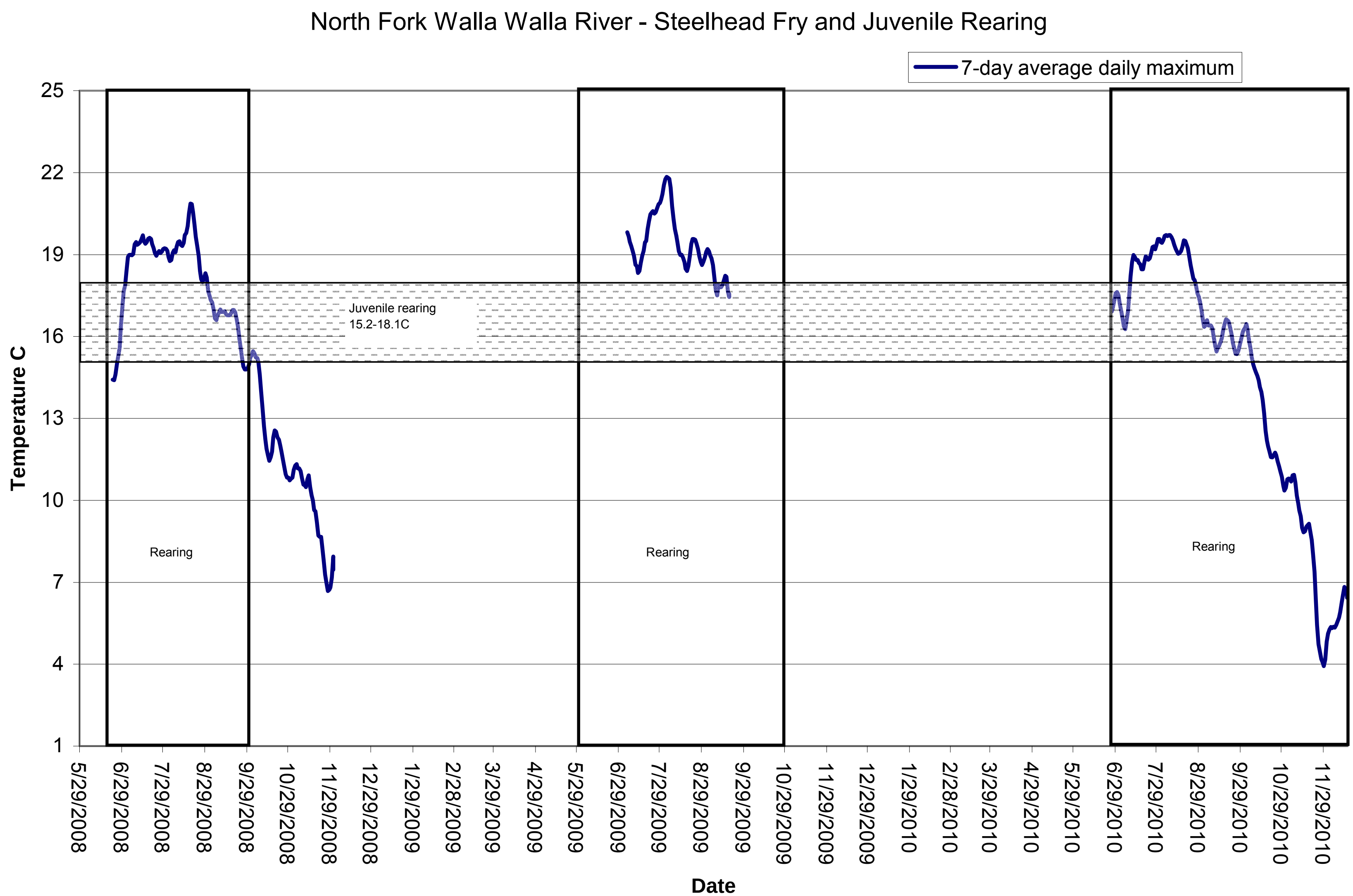


Figure E-9. Temperature profile. Juvenile Chinook and steelhead rearing in North Fork Walla Walla. Data from WWBWC gage #NF1.

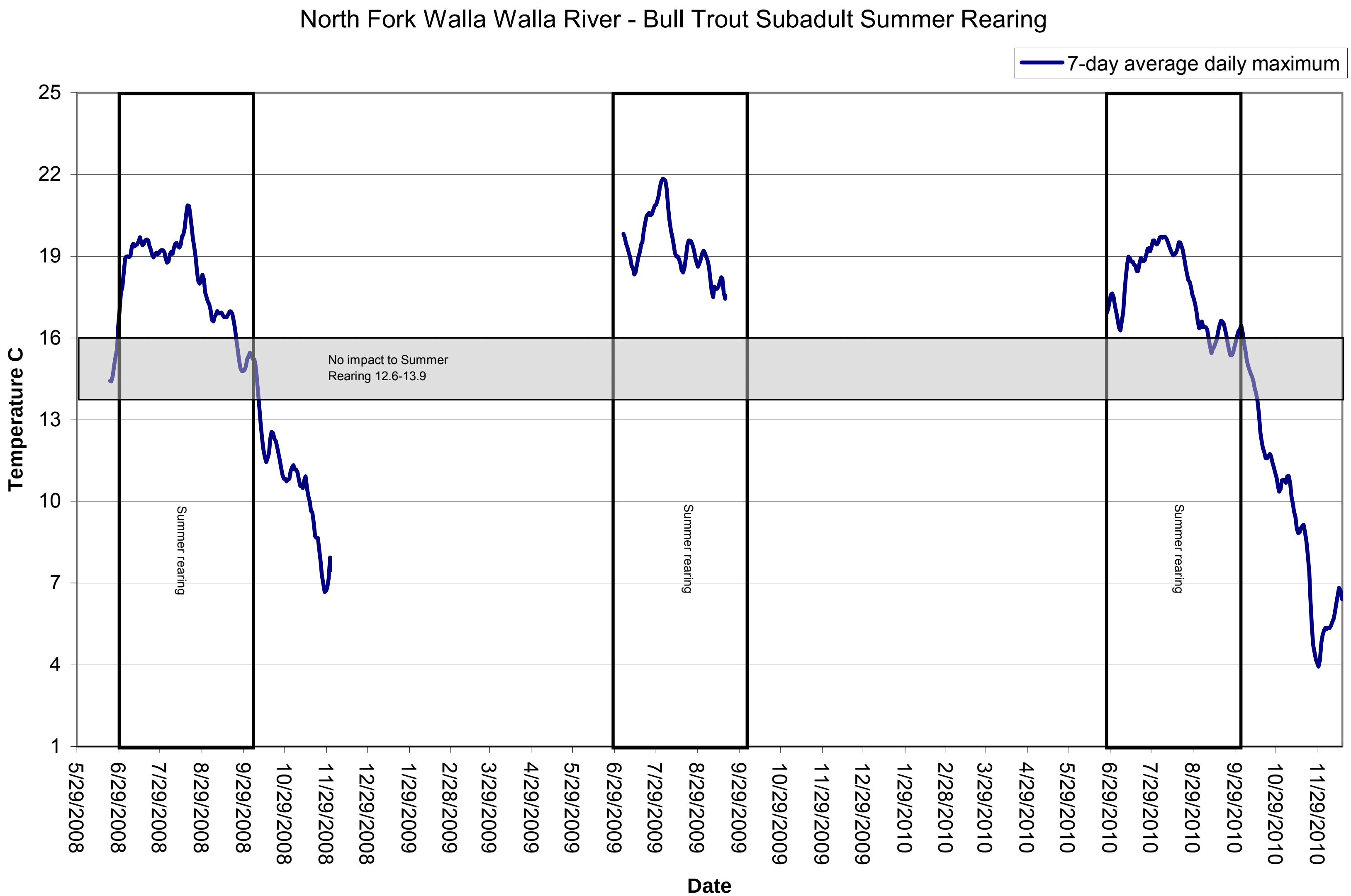


Figure E-10. Temperature profile. Bull trout subadult rearing in North Fork Walla Walla. Data from WWBWC gage #NF1.

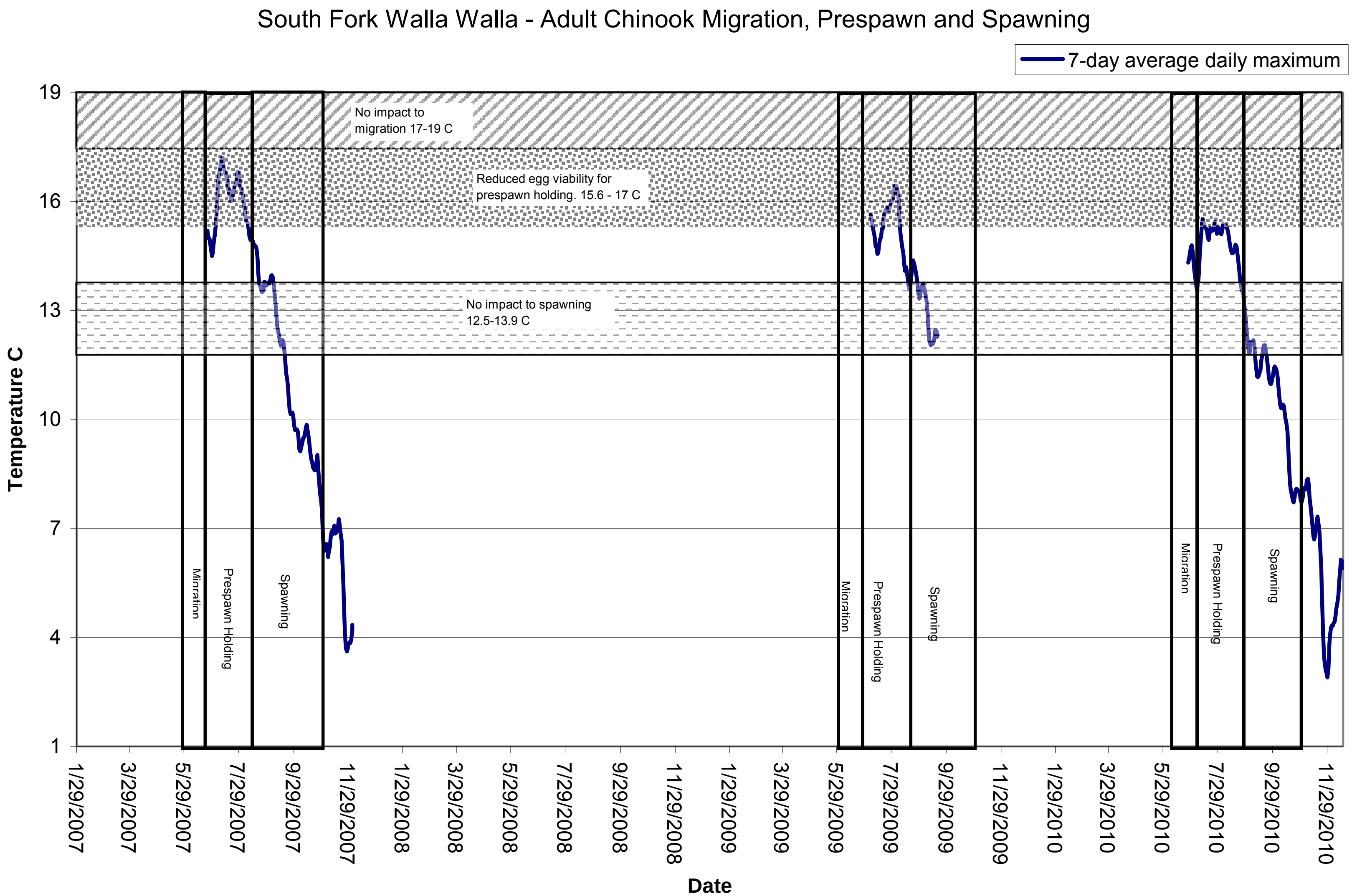


Figure E-11. Temperature profile. Chinook migration, holding and spawning South Fork Walla Walla. Data from WWBWC gage #SFWW.

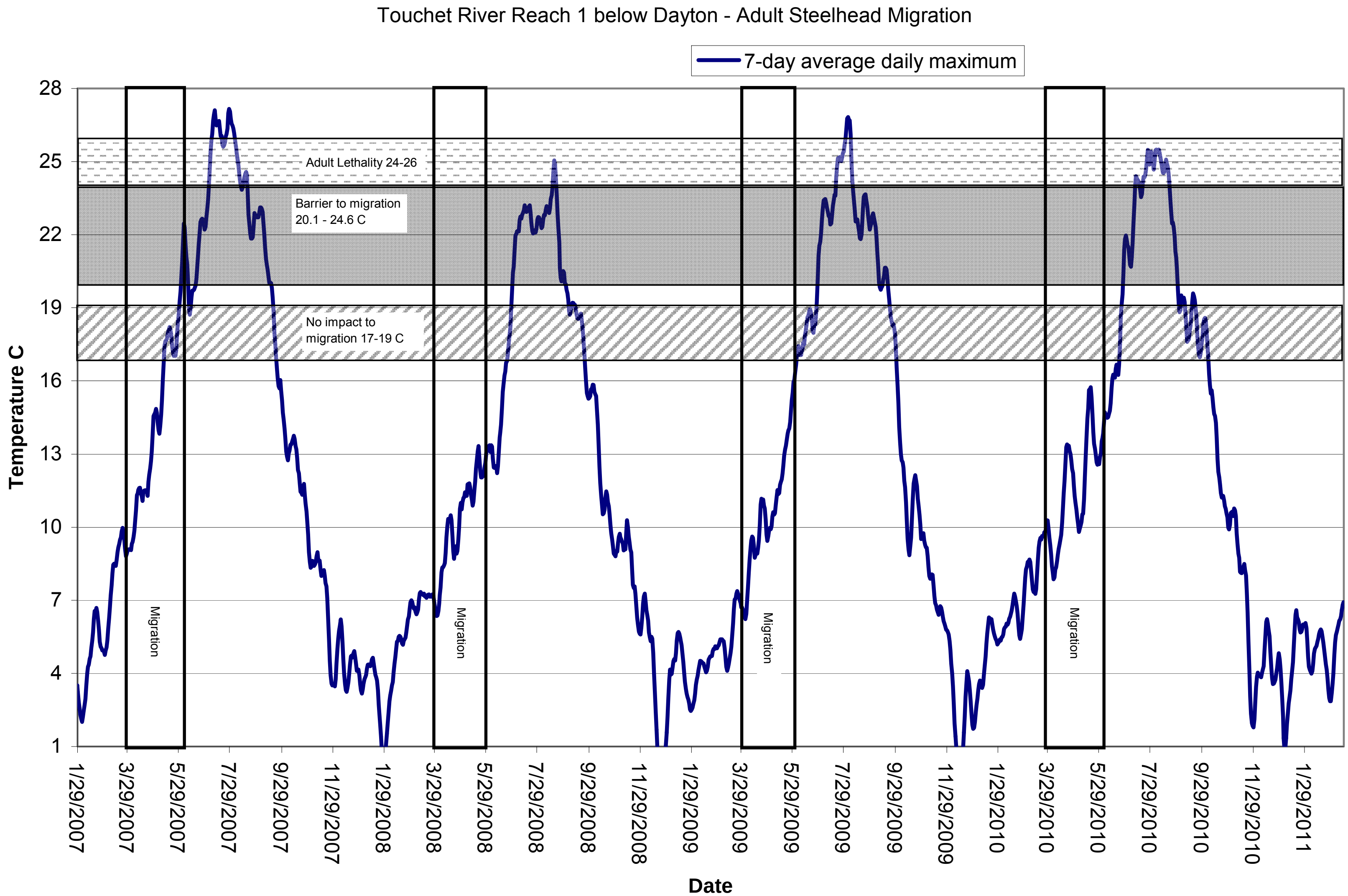


Figure E-12. Temperature profile. Adult steelhead migration in Touchet River Reach 1. Data from WDOE gage #32B100.

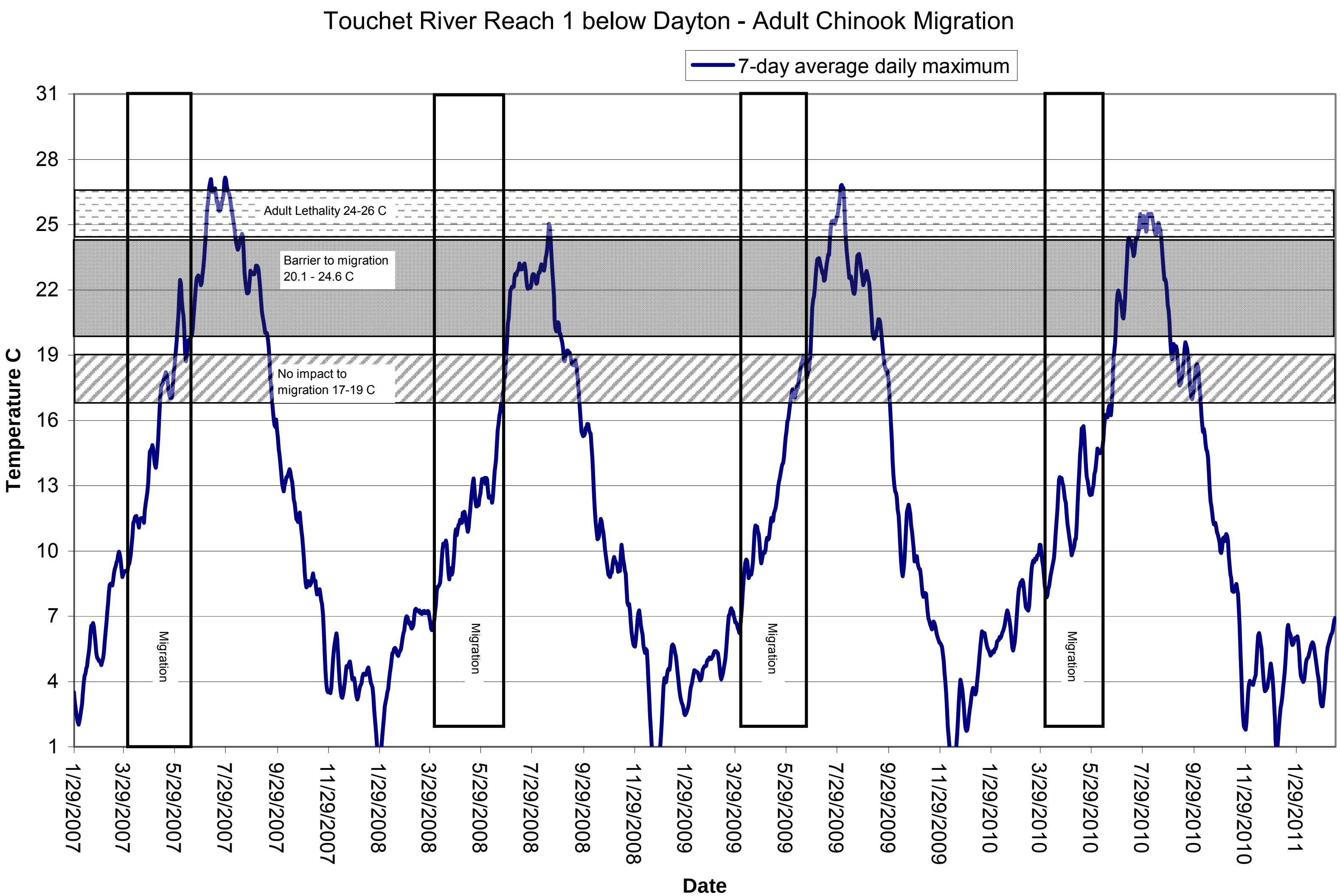


Figure E-13. Temperature profile. Adult Chinook migration in Touchet River Reach 1. Data from WDOE gage #32B100.

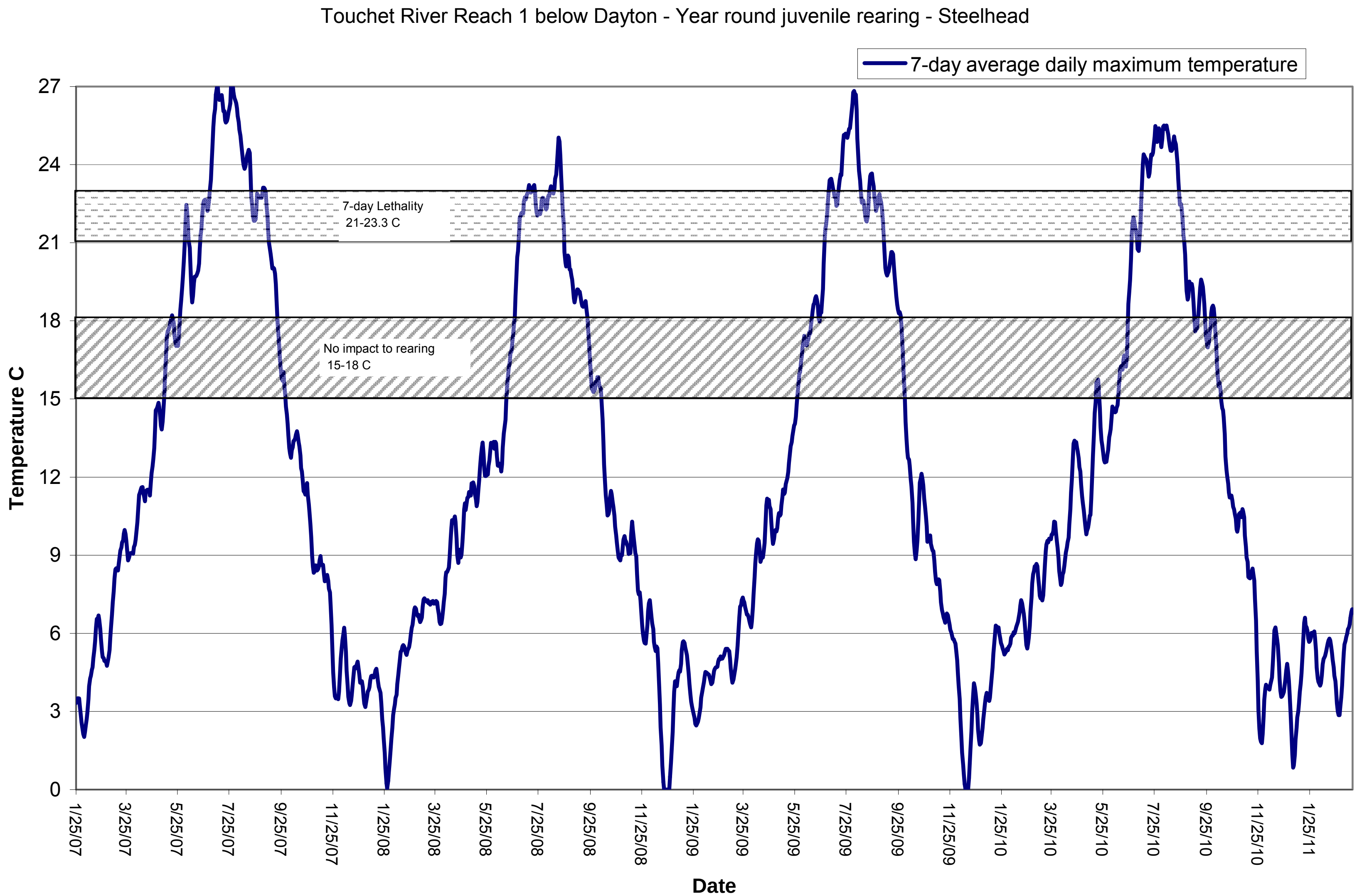


Figure E-14. Temperature profile. Juvenile steelhead rearing in Touchet River Reach 1. Data from WDOE gage #32B100.

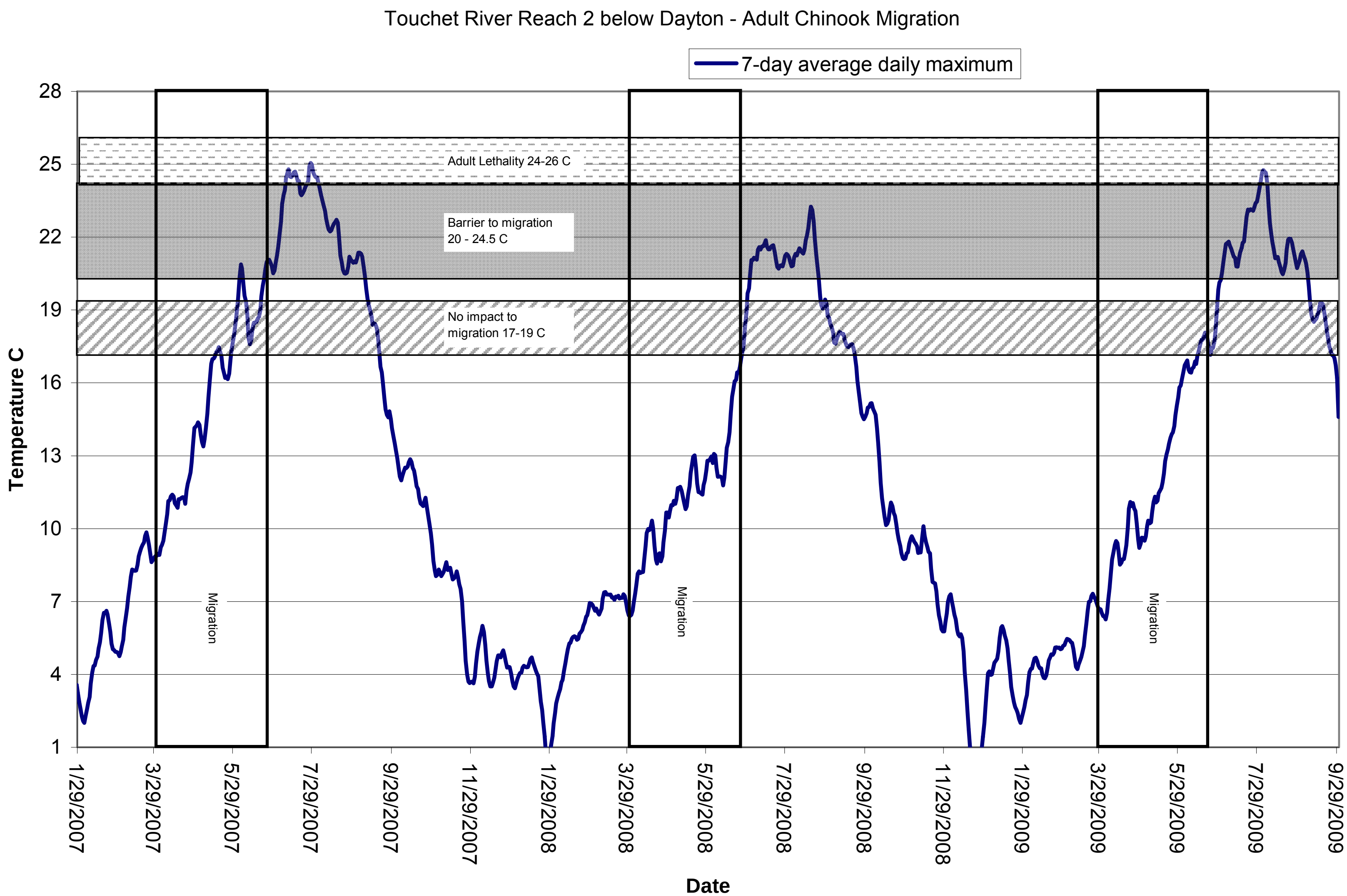


Figure E-15. Temperature profile. Adult Chinook migration in Touchet River Reach 2. Data from WDOE gage #32B110.

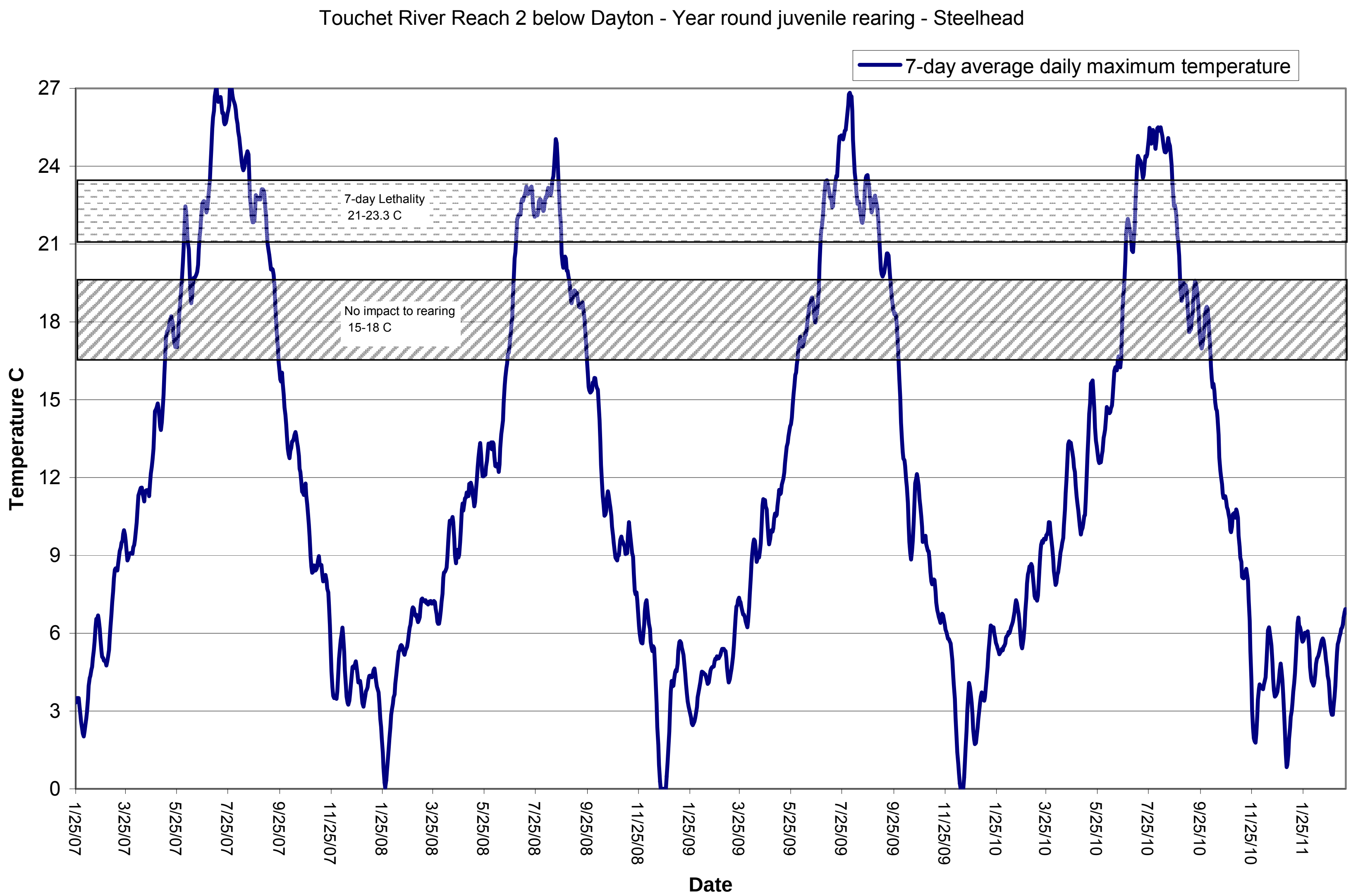


Figure E-16. Temperature profile. Juvenile steelhead rearing in Touchet River Reach 2. Data from WDOE gage #32B110.

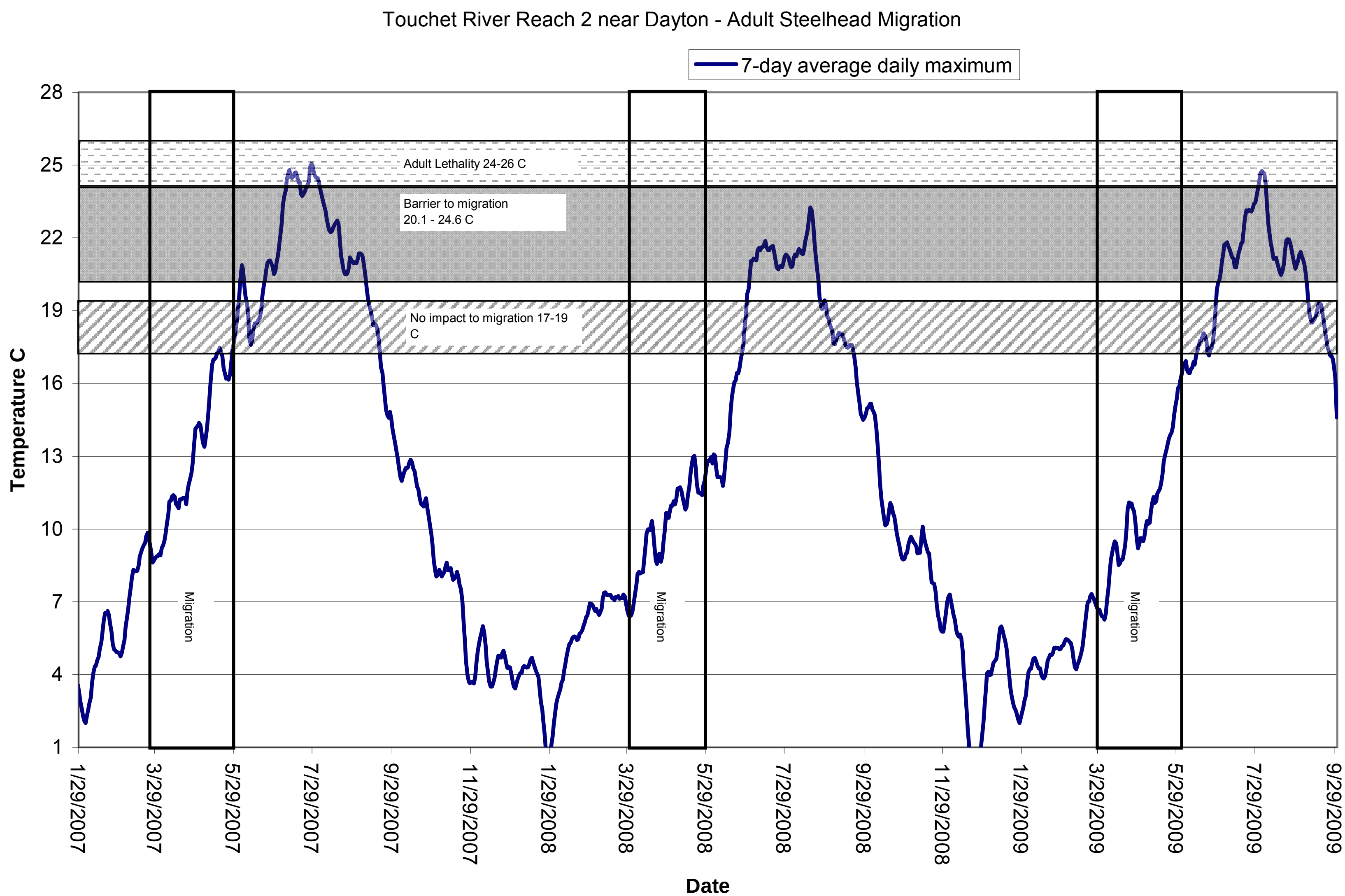


Figure E-17. Temperature profile. Steelhead migration in Touchet River Reach 2. Data from WDOE gage #32B110.

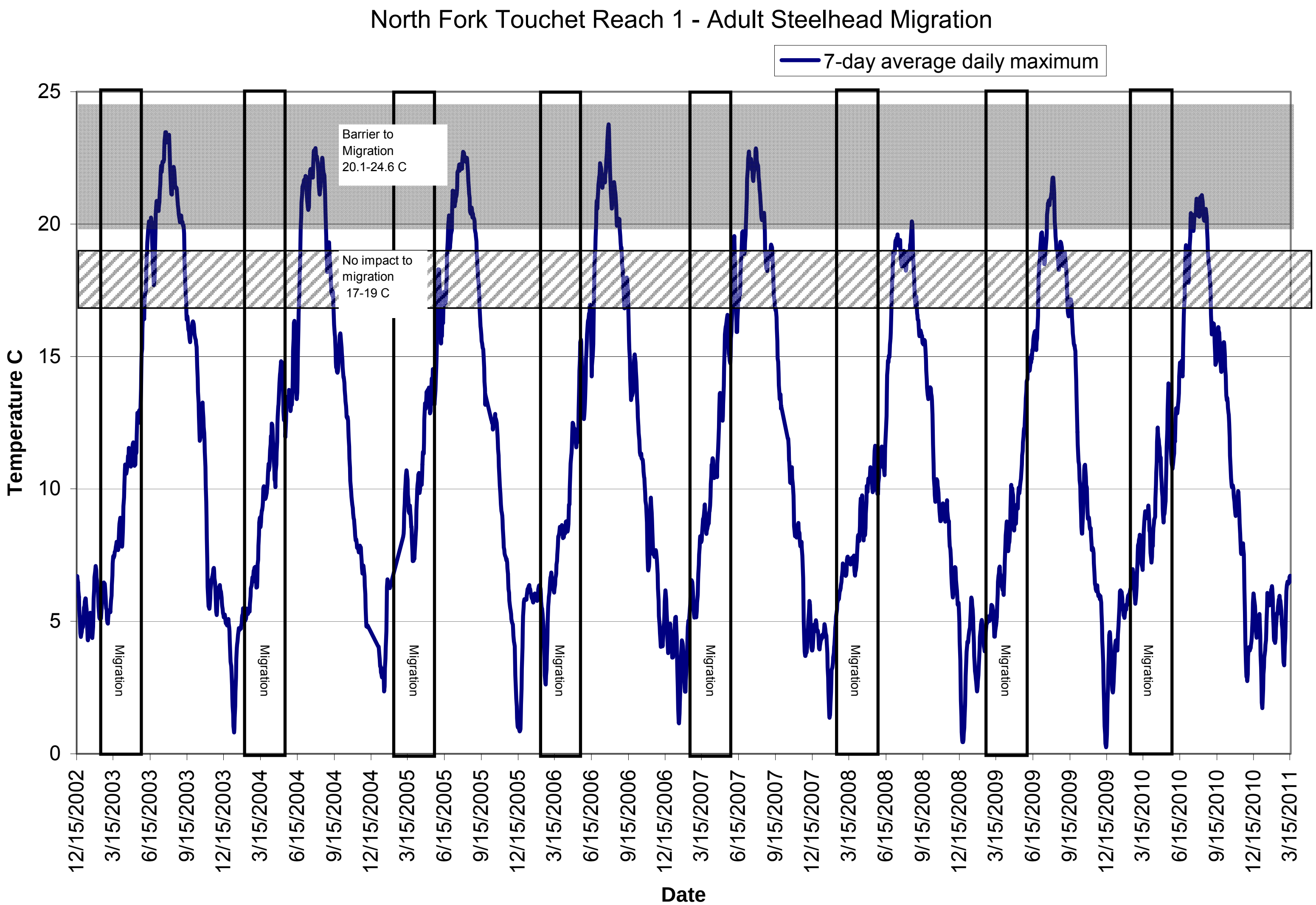


Figure E-18. Temperature profile. Steelhead migration in North Fork Touchet River. Data from WDOE gage #32E050.

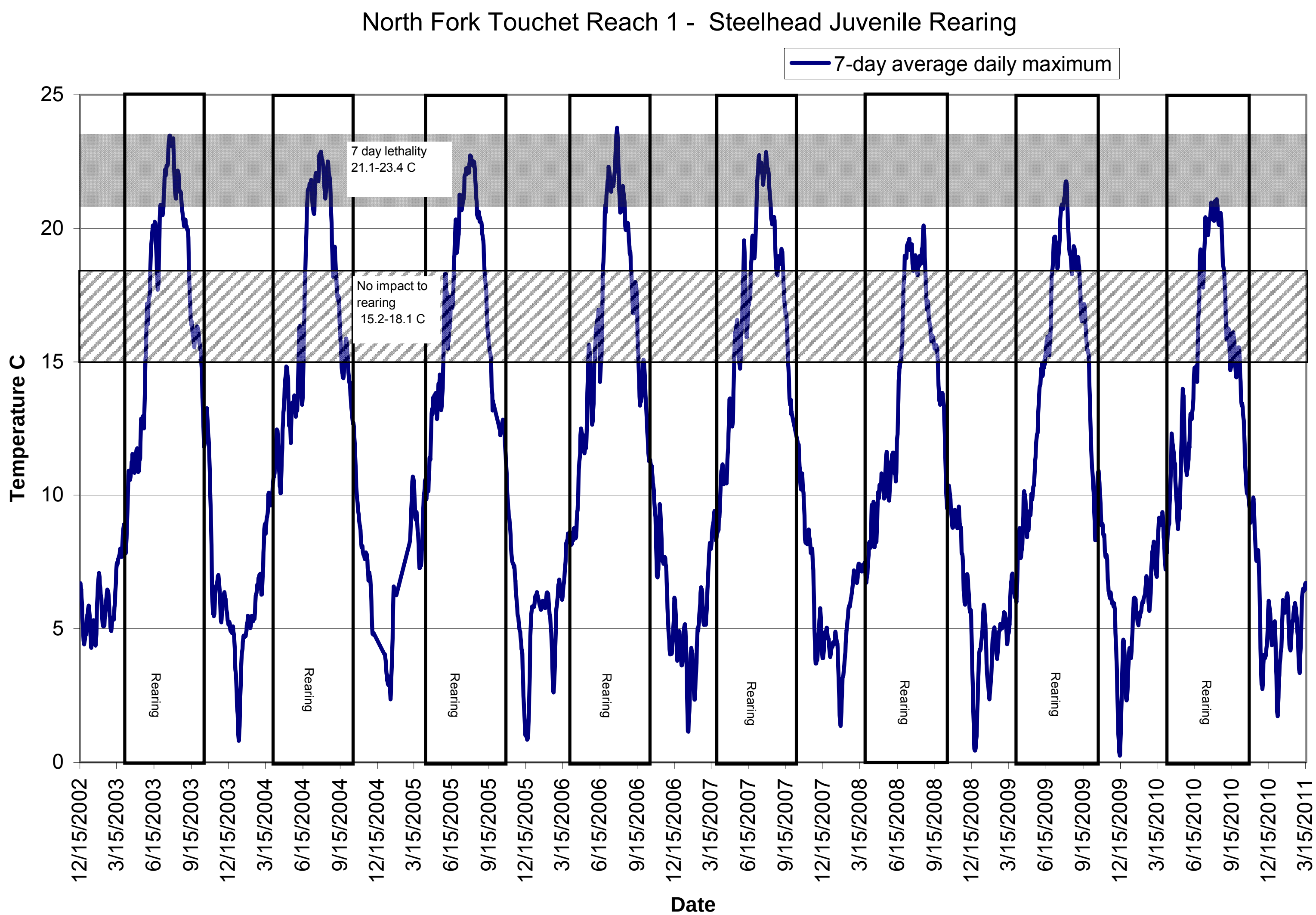


Figure E-19. Temperature profile. Juvenile steelhead rearing in North Fork Touchet River. Data from WDOE gage #32E050.

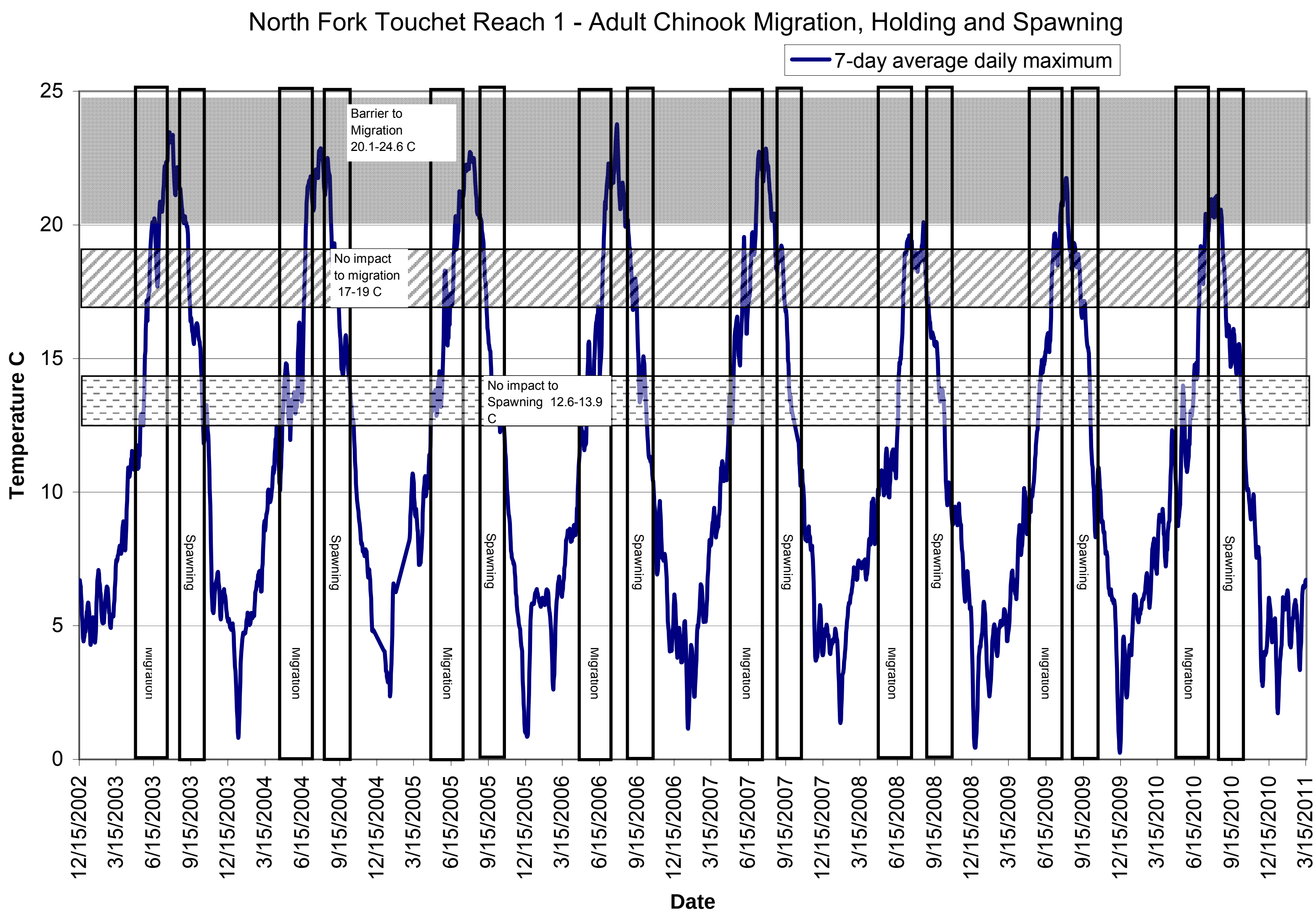


Figure E-20. Temperature profile. Chinook migration, holding and spawning in North Fork Touchet River. Data from WDOE gage #32E050.

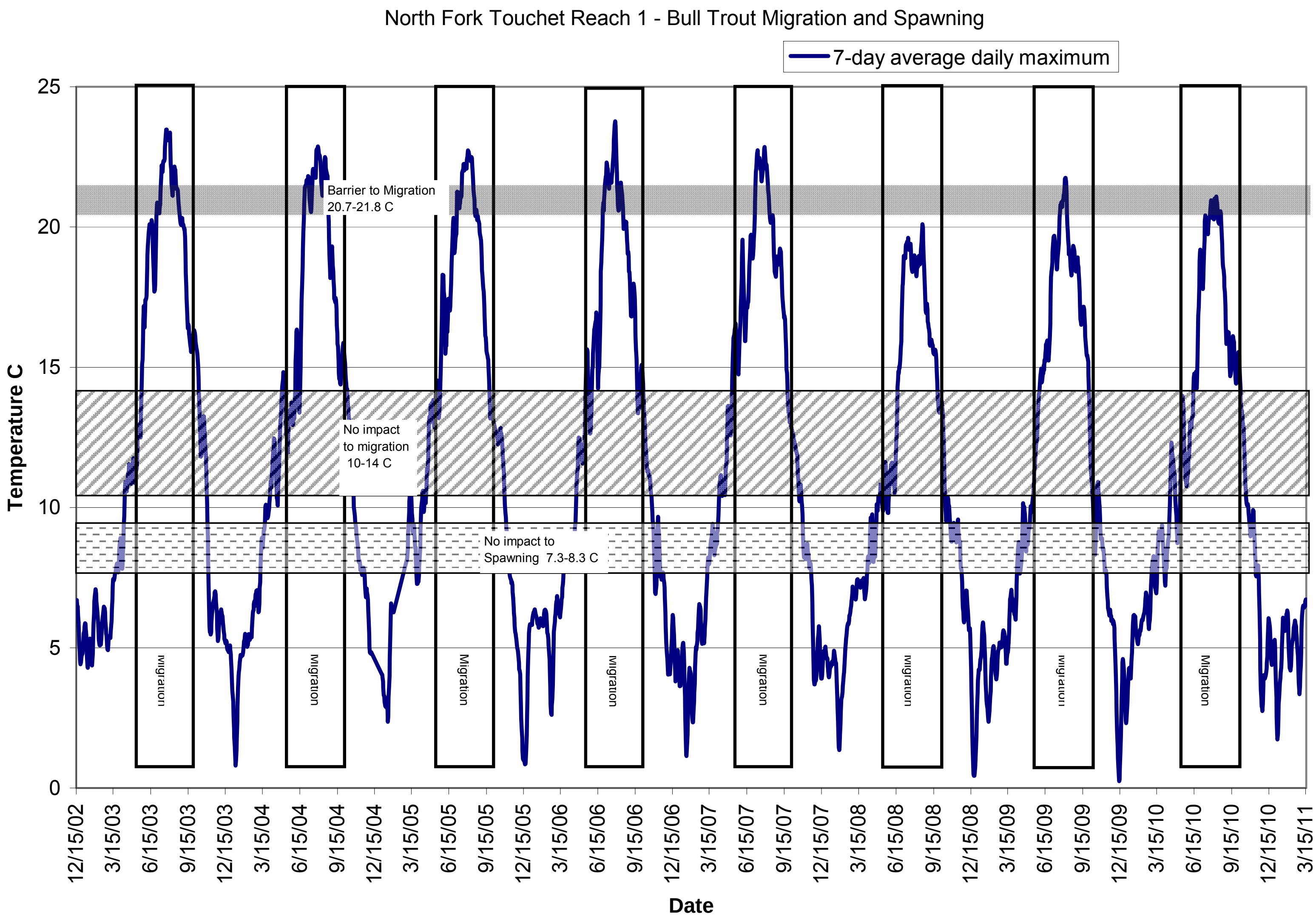


Figure E-21. Temperature profile. Bull trout migration and spawning in North Fork Touchet River. Data from WDOE gage #32E050.

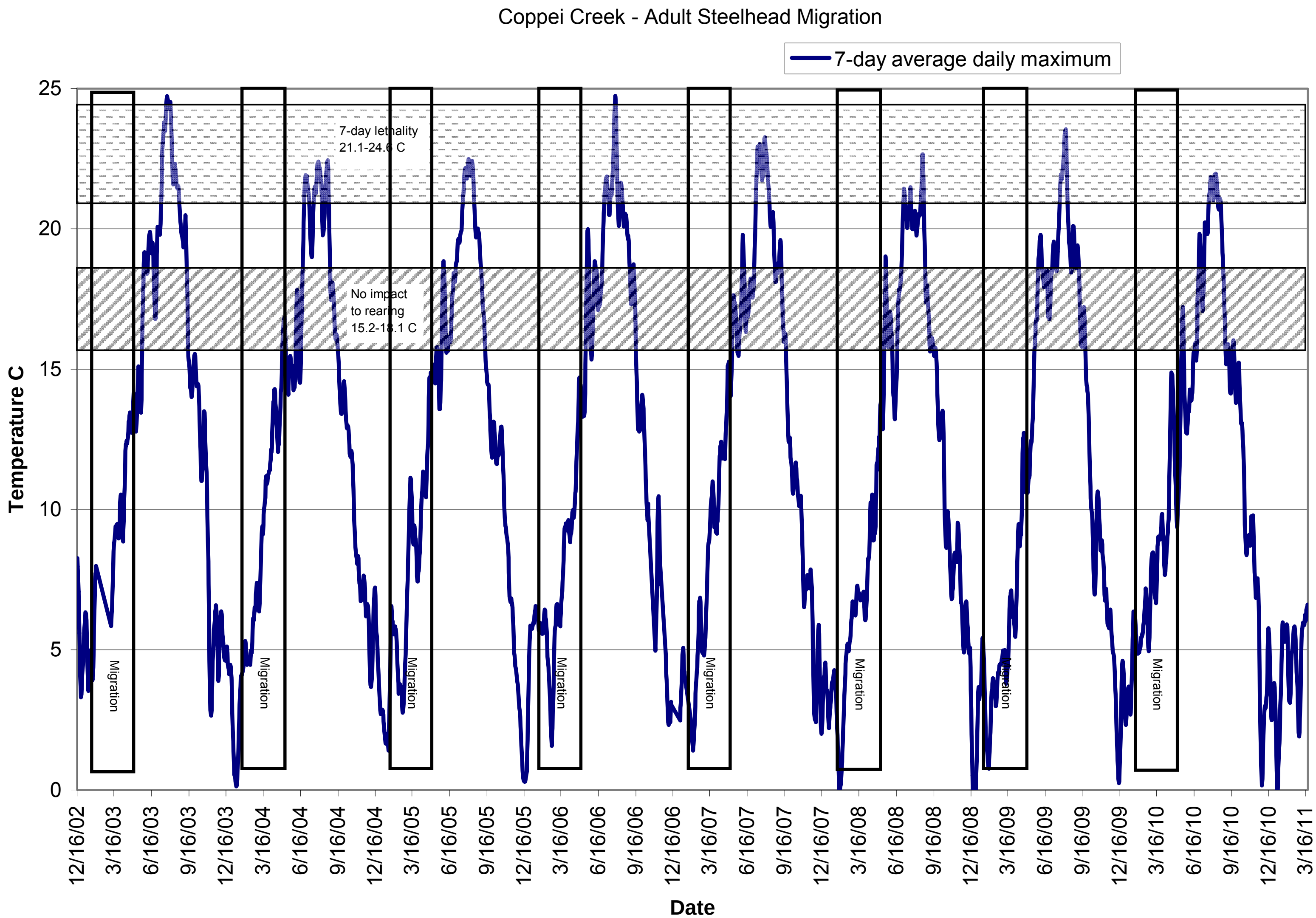


Figure E-22. Temperature profile. Steelhead migration in Coppei Creek. Data from WDOE gage #32G060.

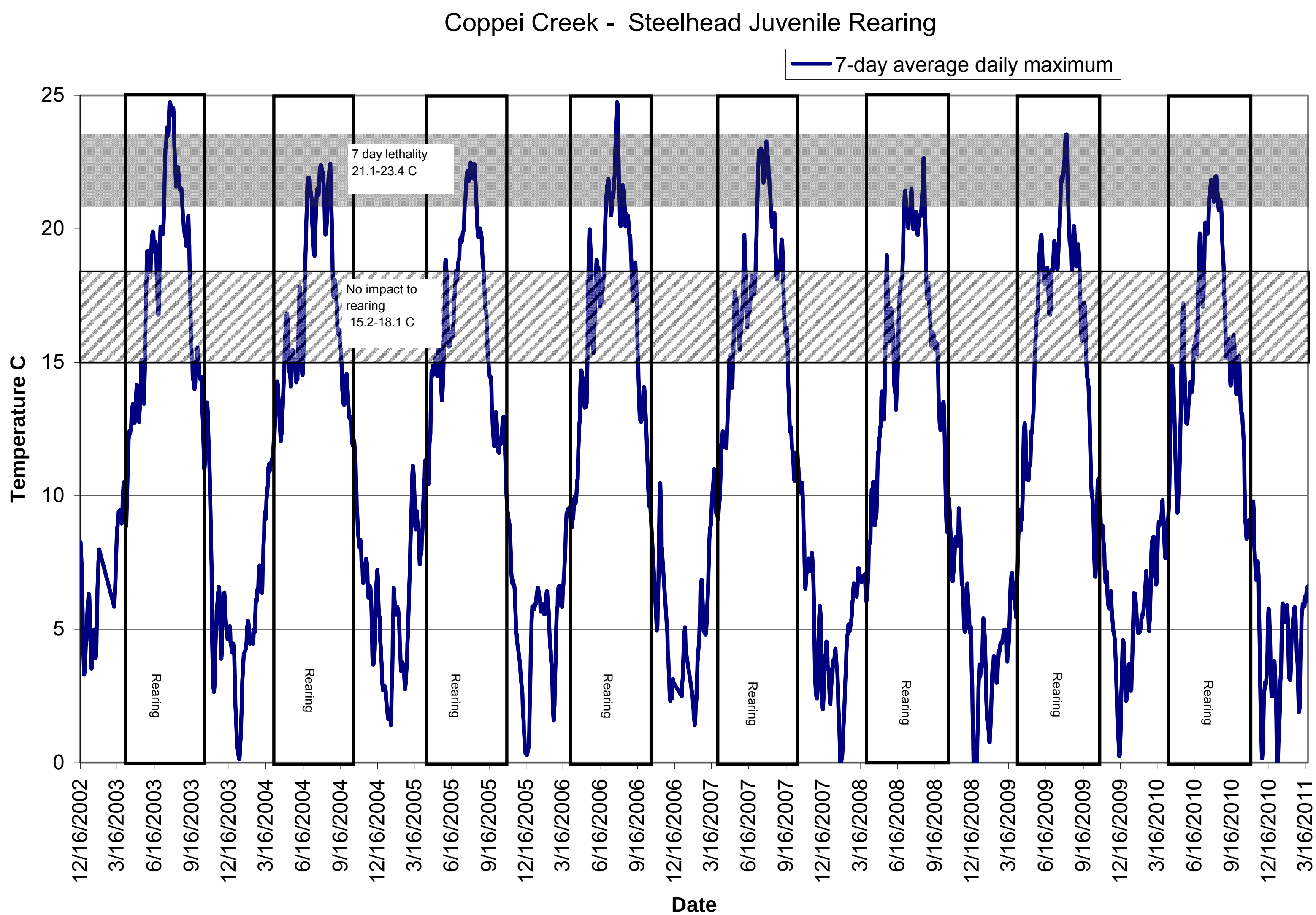


Figure E-23. Temperature profile. Juvenile steelhead rearing in Coppei Creek. Data from WDOE gage #32G060.

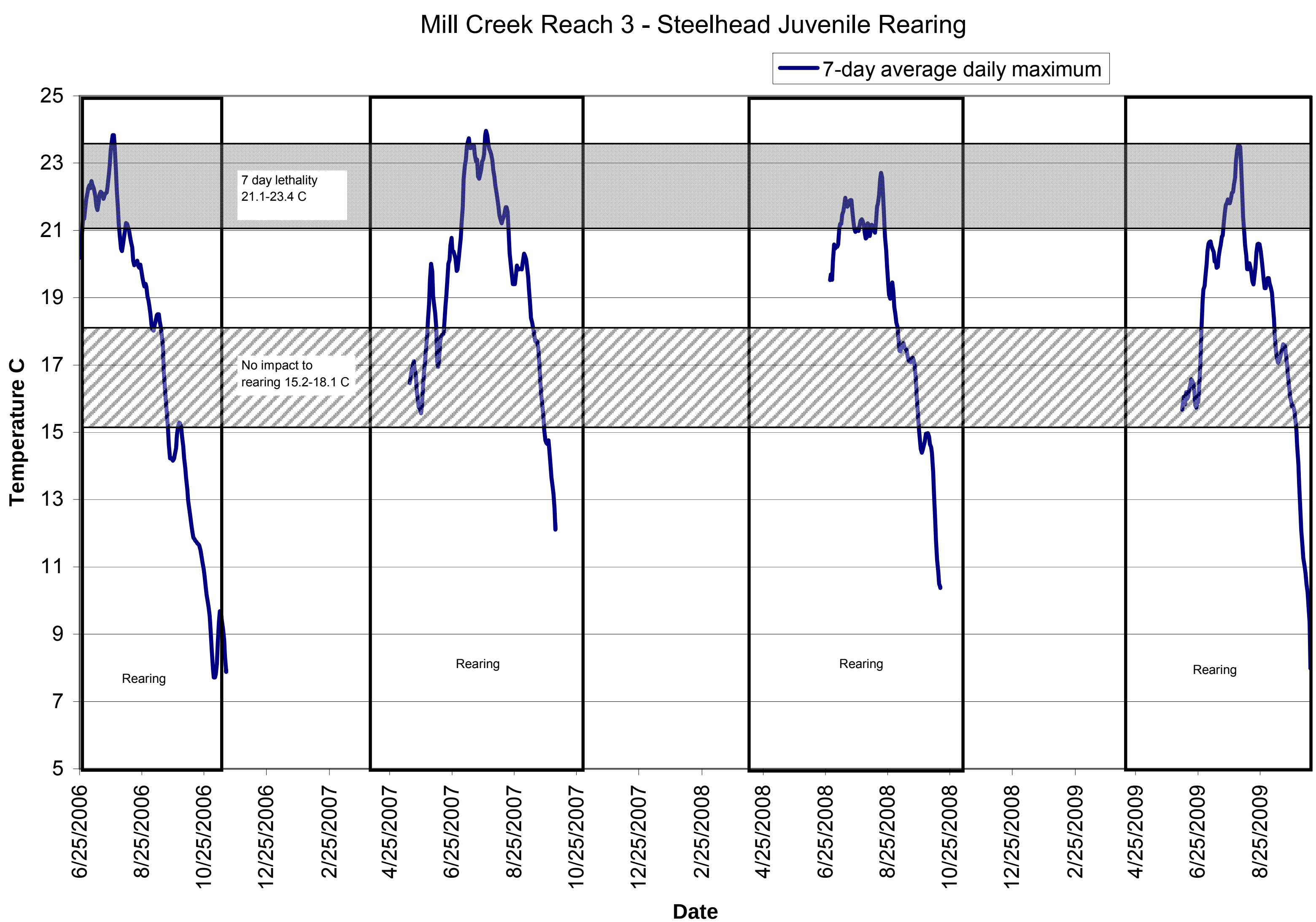


Figure E-24. Temperature profile. Juvenile steelhead rearing in Mill Creek Reach 3. Data from WDFW gage #MILFIV.

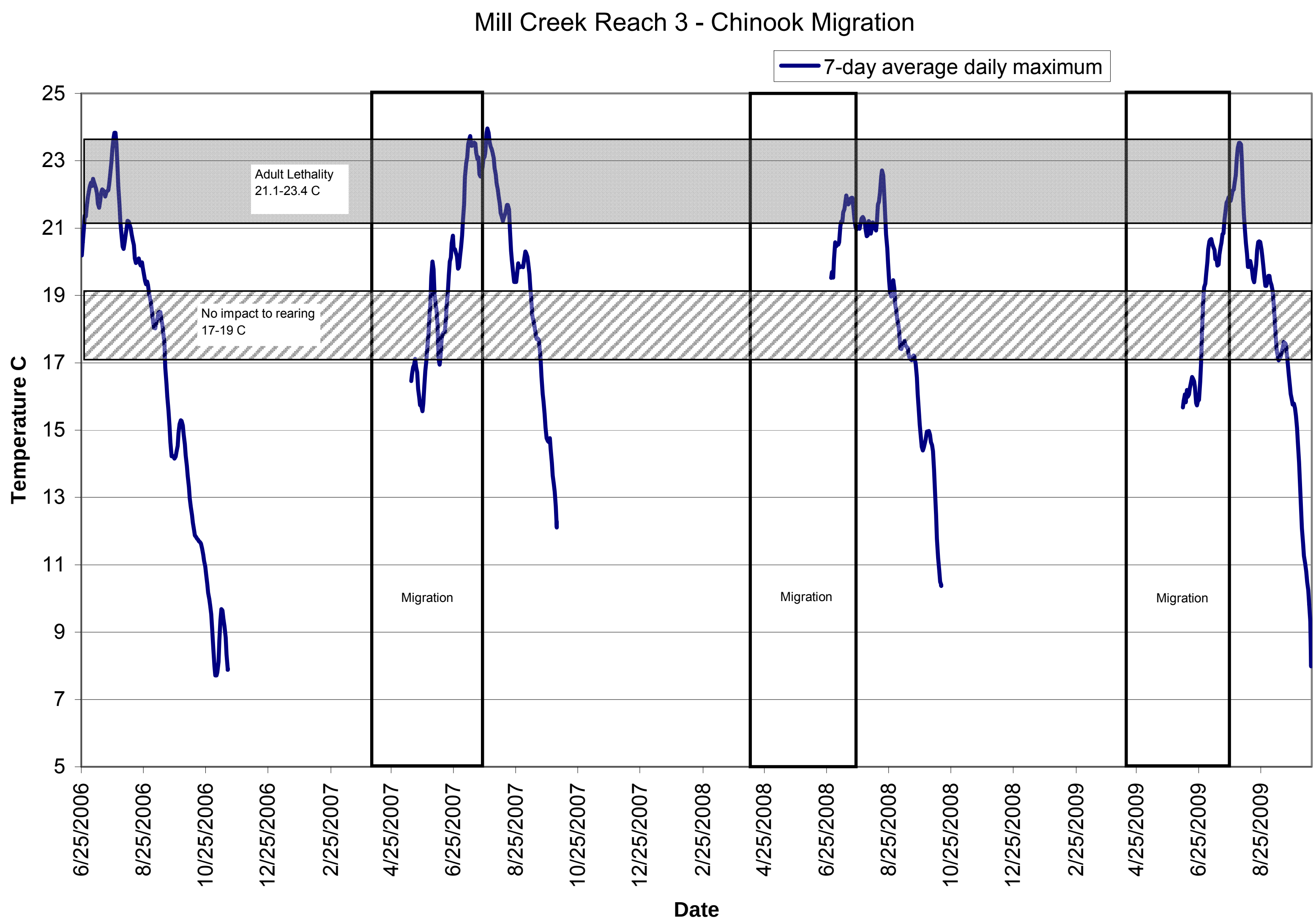


Figure E-25. Temperature profile. Adult Chinook migration in Mill Creek Reach 3. Data from WDFW gage #MILFIV.

Appendix F

Stetson Irrigation Memo

DRAFT TECHNICAL MEMORANDUM

STETSON ENGINEERS INC.

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TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: julianf@stetsonengineers.com

TO:	Jody Lando, Ph.D.	DATE:	January 31, 2011
FROM:	Stetson Engineers Inc.	JOB NO:	2119-003

RE: Walla Walla Basin Irrigation Diversions

Introduction

The purpose of this draft memorandum is to summarize available information related to irrigation diversions in the Walla Walla watershed. This includes relevant reports and analyses, available water rights information, and gaged and estimated irrigation diversion data.

Oregon Diversions

In the Oregon portion of the basin, the Oregon Water Resources Department (OWRD) is responsible for regulating water use based on Oregon water laws and water rights. OWRD manages approximately 90 diversions on the Little Walla Walla River, 20 on the South Fork Walla Walla River, 10 on the North Fork Walla Walla River, 6 on the mainstem Walla Walla River, and 120 on other small Walla Walla River tributaries (OWRD, 2002).

OWRD manages the system by shutting off diversions to junior water right holders (priority date after 1903) when streamflows are low. Although instantaneous ditch diversion flows are measured during low flow periods, daily diversion flows for water uses in the Oregon portion of the watershed are not recorded (Tony Justus, OWRD, personal communication, January 6, 2011). Attachment B contains a list of water rights for diversions from the Walla Walla River in the Oregon portion of the watershed, provided by OWRD.

Washington Diversions

The Washington Department of Ecology (WDOE) is responsible for managing water rights and diversions in the Washington portion of the watershed. Currently, the WDOE is without a watermaster and the watermaster duties are shared several staff members.

The Pacific Groundwater Group (PGG, 1995) prepared an assessment report summarizing water rights and demand in the Washington portion of the Walla Walla watershed. As of 1994, reported maximum allowable annual withdrawals for surface-water permits and certificates in the Washington portion of the Walla Walla watershed totaled 253,020 acre-feet per year (afy). Groundwater permits/certificates totaled 260,173 afy. The total estimated annual withdrawals for permits, certificates, and claims for both surface and groundwater was 550,569 afy and the total estimated maximum instantaneous withdrawal is 3,925 cfs. A significant majority of surface water rights in the Walla Walla are for irrigation uses, which comprise 99% of the total allocated volume.

Estimates of surface water diversions are approximately 46,200 acre-feet per year. Therefore, actual water diversions are approximately 18% of the total surface water rights, or 253,000 afy (PGG, 1995).

Attachment C contains a list of water rights for diversions from the Walla Walla River in the Washington portion of the watershed, as provided by the WDOE.

Irrigation Diversions

The following is a list of the primary irrigation districts and private ditches in the watershed:

Walla Walla River (Oregon)

- Walla Walla River Irrigation District (WWRID)
- Hudson Bay Irrigation District (HBDID)

Walla Walla River (Washington)

- Gardena Farms Irrigation District # 13 (GFID)
- Smith
- Bergevin/Williams
- Lowden No. 2
- Garden City
- Old Lowden

Touchet River

- West End Irrigation Ditch (WEID)
- East End Irrigation Ditch (ENID)
- Hearn Irrigation Ditch

Mill Creek and Garrison Creek

- Rec. Fields Ditch (Mill Creek)

- Blalock Dist. No. 3 (Mill Creek)
- Titus Cr. Ditch
- Garrison Creek South
- Garrison Creek North

Walla Walla River Diversions

About 70% of the surface irrigation water in Oregon is delivered through two irrigation districts, the Walla Walla River Irrigation District (WWRID) and the Hudson Bay District Improvement Company (HBDIC). The combined water rights for the two districts is approximately 280 cfs and the combined peak diversion rate is approximately 150 cfs in June, which falls to about 60 cfs in September (AqWQM, 2007).

The primary diversion locations for both WWRID and HBDIC is at Cemetery Bridge where flows are diverted into the Little Walla Walla River. A OWRD/USGS gaging station (Gage No. 14012100) records the total diverted flow at the diversion point. The Little Walla Walla River is a former braided stream section of the Walla Walla River and is considered by court order to be a natural stream even though the flows are regulated by headgates. Flow in the Little Walla Walla River is divided to the WWRID and HBDIC at a structure called the Frog. A second OWRD/USGS gaging station (14012300) records total diverted flow to the HBDIC. Therefore, the total flow going to the WWRID can be found by subtracting flows at the two gages. The maximum design capacity of the Little Walla Walla Diversion is 225 cfs and the maximum capacity through Milton-Freewater is less than 200 cfs (ACOE, 2010).

North Fork and South Fork Walla Walla River Irrigation Diversions

Water diversions above Milton-Freewater are generally by individual or small group users without organized irrigation districts. According to the Agricultural Water Quality Management Plan these diversions total about 30 cfs (AgWQM, 2007). According to the ACOE (2010) Study, the total quantity of water rights upstream of Milton-Freewater is approximately 20 cfs. A list of all the water rights upstream of Milton-Freewater is included as Appendix A of the Water Conservation Plan (SCM, 2003). A table of all the water rights on the Walla Walla River in the Oregon portion of the basin is included as Attachment B of this memorandum, as provided by the OWRD.

Walla Walla River Irrigation District (WWRID)

The WWRID delivers water to about 3,600 acres with water rights from the Walla Walla River. The district has four diversion points although only two are currently active:

- Little Walla Walla River Diversion (Active)
- Smith Ditch Diversion (Inactive)
- Eastside Canal Diversion (Active)
- Milton Ditch Diversion (Inactive, uses Little Walla Walla Diversion)

Water Rights for the WWRID are shown in Table 1.

Table 1 WWRID Diversion and Water Rights (ACOE, 2010)

Diversion Location	Water Right (cfs)	Dates of Regulation
Frog	64.5	15 April to 1 June
Frog	61.5	1 June to 15 June
Frog	58.5	15 June to 1 October
Eastside	14	Unregulated
Eastside	9.2	Regulated
Powell/Pleasant View	23	Unregulated
Powell/Pleasant View	9.5	Regulated
Milton Ditch	20	Unregulated
Milton Ditch	8	Regulated

Notes
Table adopted from the ACOE 2010 Draft Environmental Impact Statement, Appendix A
Unregulated flows are taken during high flow periods and low flow periods are regulated

SCM Consultants (2003) developed a Water Conservation Plan from the WWRID. This plan included an analysis of the existing system, estimate of canal/ditch losses, and estimation of WWRID average and peak demand (Tables 1 and 2).

	Little Walla Walla River Diversion (AF)	Eastside Diversion (AF)	Smith Ditch Diversion (AF)	Milton Ditch Diversion (AF)	Total Diversion (AF)	Total Ave Flow (CFS)
March	459	32	0	0	491	16
April	2,135	199	52	206	2,592	44
May	3,015	332	57	236	3,640	59
June	4,298	469	33	247	5,047	85
July	4,458	606	27	315	5,406	88
August	4,253	596	16	306	5,171	84
September	3,892	487	18	256	4,653	78
October	1,431	189	6	49	1,675	27
November	509	0	0	0	509	17
Annual	24,450	2,910	209	1,615	29,184	--

Notes
Table adopted from SCM Consultant Inc, 2003 Water Conservation Plan, Table 2-6.
Average monthly demands based on gaged data from 1995 through 2001.

Table 2 Estimated Average WWRID Diversion Volumes (SCM, 2003)

Table 3 WWRID Peak Daily Flow Rates (SCM, 2003)

Ford, Crocket and Powell/Pleasant View	111 cfs
Eastside Canal	19 cfs
Milton Ditch	6 cfs
Smith Ditch	1 cfs

Notes
Table adopted from SCM Consultant Inc, 2003 Water Conservation Plan, Table 2-8.
Peak average daily flows typically occur in late June and early July

Hudson Bay District Improvement Company (HBDIC)

The HBDIC delivers water to approximately 6,900 acres with Walla Walla River surface rights (AqWQM, 2007). The district has two point of diversion from the Walla Walla River, although only one is currently active:

- Little Walla Walla River Diversion
- POD #1 or Frost Ditch (Inactive)

The HBDIC has a total water right of 224.96 cfs from the Cemetery Bridge diversion (Little Walla Walla River). However, some of the water rights are supplemental and all but 98.83 cfs have a priority date after 1903 (ACOE, 2010). Without use of POD #1, HBDIC cannot use its full water right allocation at the same time due to capacity limitations of the Little Walla Walla River.

Gardena Farms Irrigation District #13 (GFID)

GFID is the largest irrigation district in the Washington portion of the Walla Walla Watershed. The district has a single diversion from the Walla Walla River, located just upstream from Beet Road Bridge, which diverts water into Burlingame Canal. GFID has a single water right with a priority date of 1892. The water right allows for irrigation of 7,000 acres with maximum diversion rates as follows (ACOE, 2010):

- April 1 to July 1: 93.33 cfs
- July 1 to October 1: 70 cfs
- October 1 to April 1: 140 cfs

GFID uses most of their water right, except when they are being regulated for senior water rights in the summer (WDOE, 2010).

Additional Walla Walla River Washington Irrigation Diversions

Water rights for several of the larger irrigation districts and ditches diverting from the Walla Walla River (in Washington) are shown in Table 4. This information in Table 4 was provided by the WDOE (Daniel Tolleson, personal communication, January, 24, 2011). Attachment C contains a list of all the water rights for diversions from the Walla Walla River in the Washington portion of the watershed, as provided by the WDOE.

Table 4 Walla Walla River Diversions (WDOE, 2010)

Smith / Nelson Ditch (329 acres)	
April 1 to July 1	4.512 cfs
July 1 to October 1	1.75 cfs
October 1 to April 1	6.38 cfs
Bergevin/Williams (1,098 acres)	
April 1 to July 1	8.85 cfs
July 1 to October 1	5.73 cfs
October 1 to April 1	8.85 cfs
Lowden No. 2	
April 1 to July 1	18.61 cfs
July 1 to October 1	8.21 cfs
Less Mud Creek rights	5.98 cfs
October 1 to April 1	25.39 cfs
Garden City	
April 1 to June 15	15.78 cfs
June 15 to July 1	14.61 cfs
July 1 to October 1	10.41 cfs
October 1 to April 1	22.9 cfs
Old Lowden Ditch (1,332 acres)	
April 1 to July 1	9 cfs
July 1 to October 1	7.781 cfs
October 1 to April 1	9 cfs

Notes
Data provided by WDOE (2010)
Flows represent unregulated diversions.

Touchet River Diversions

Irrigation diversions from the Touchet River occur along the river from above Dayton to just above the town of Touchet. The large majority of irrigation diversion on the Touchet are small private irrigators. The largest irrigation districts diverting from the Touchet River are the Eastside #7 (EID) and Westside #5 (WID) Irrigation Districts. These two irrigation districts both divert near the mouth of the Touchet River at Hofer Dam. Near the diversion from the Touchet, the canal bifurcates into the Westside Ditch and Eastside Ditch. The combined diversion rate of the two districts is as follows (ACOE, 2010):

- April 1 to September 15: 30.353 cfs
- September 15 to April 1: 39.459 cfs

Several smaller irrigation districts and ditch companies have diversion points near Dayton, WA. Water rights for several of districts and ditches are shown in Table 5. This information in Table 5 was provided by the WDOE (Daniel Tolleson, personal communication, January, 24, 2011).

Table 5 Dayton Irrigation Ditch Diversions (WDOE, 2010)

Hearn Irrigation Ditch (41 acres)	
April 1 to September 15	0.547 cfs
September 15 to April 1	0.82 cfs
West End Irrigation District (238.7 acres)	
April 1 to September 15	3.161 cfs
September 15 to April 1	4.773 cfs
East End Irrigation District	1.078 cfs

Notes
Diversion data provided by the WDOE (2010)
Diversion flows may represent multiple water rights.

Mill Creek, Yellowhawk Creek and Garrison Creek Irrigation Diversions

Similar to the larger rivers in the Walla Walla Watershed, there are many small private and small ditch company diversions from Mill Creek, Yellowhawk Creek and Garrison Creek. Water rights for three of these small diversions are shown in Table 6. This information in Table 6 was provided by the WDOE (Daniel Tolleson, personal communication, January, 24, 2011).

Table 6 Mill Creek and Garrison Creek Diversions (WDOE, 2010)

Garrison Creek North Ditch (5.25 acres)	
April 1 to July 1	0.07 cfs
July 1 to October 1	0.0525 cfs
October 1 to April 1	0.105 cfs
Garrison Creek South Ditch	
October 1 to July 1	0.44 cfs
July 1 to October 1	0.22 cfs
Rec. Fields Ditch (Mill Creek)	
October 1 to July 1	0.75 cfs
July 1 to October 1	0.44 cfs

Notes
Diversion data provided by the WDOE (2010)
Diversion flows may represent multiple water rights.

Settlement Agreement (FWS, 2004)

A settlement agreement between the U.S. Fish and Wildlife Service (FWS) and the HBDIC, WWRID and GFID was originally reached on June 9, 2000. The agreement was reached after the FWS informed the WWRID and HBDIC of potential violations to the Endangered Species Act (ESA) as a result of their water delivery operations by dewatering the Walla Walla River in 1998 and 1999. The latest version of this agreement was signed August 4, 2003 and specifies minimum instream flows at the Districts diversion points. The HBDIC and WWRID agreed to ensure a minimum instream flow of 27 cfs in June and 25 cfs for the remainder of the year at the Nursery Bridge Dam. The GFID agreed to ensure a minimum instream flow of 19 cfs during June and 18 cfs for the remainder of the year at just below the Burlingame Diversion.

Diversion Location Maps

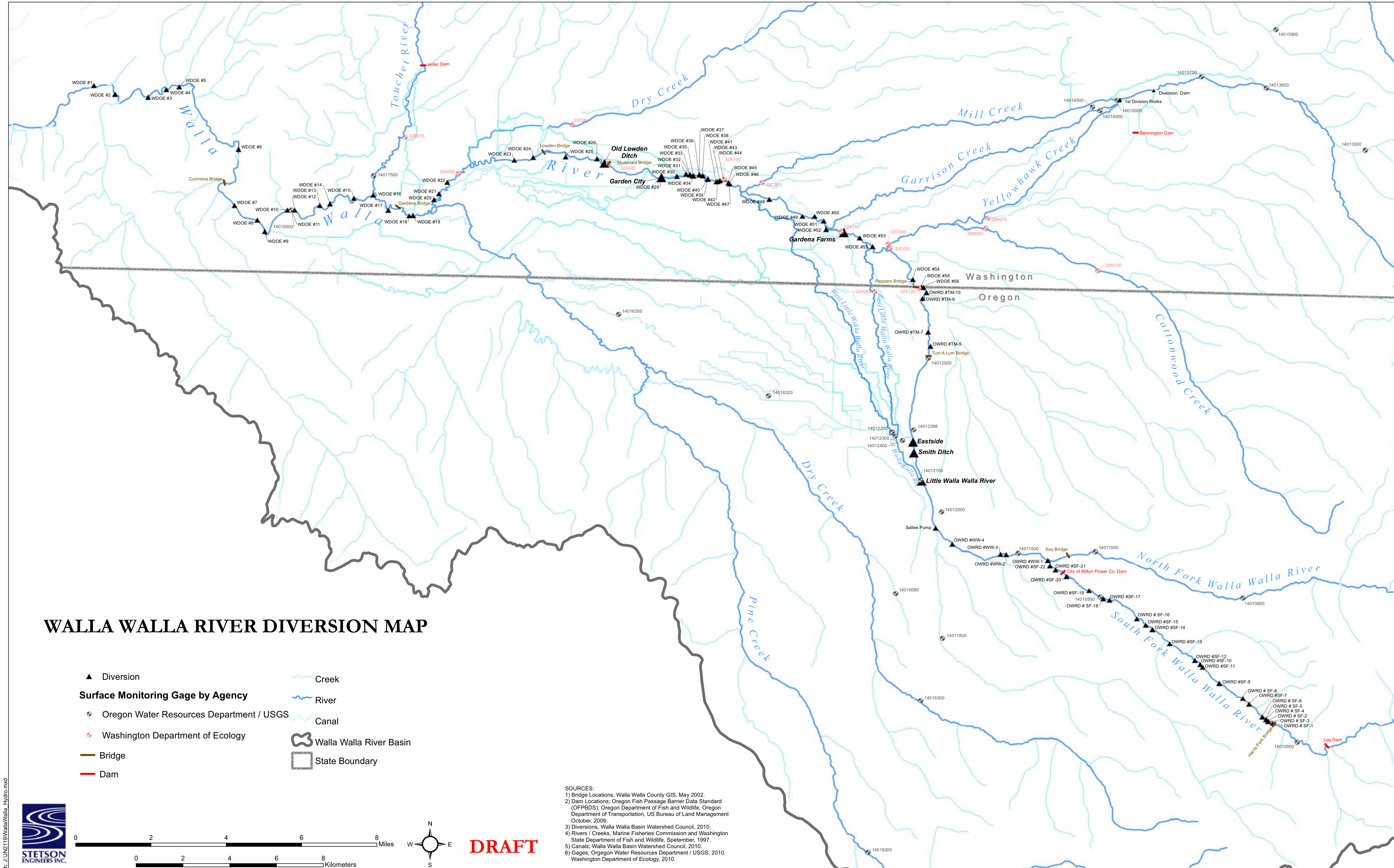
Stetson Engineers has created a map of the Walla Walla River showing diversion locations, gaging stations and other important features, as shown in Figure 1. The extent of the map includes diversions along Mill Creek and the lower Touchet River.

A Point of Diversion (POD) map, provided by OWRD, shows diversion locations on the North Fork, South Fork and mainstem Walla Walla River in Oregon.

Several figures are included in the Initial Watershed Assessment showing the distribution of surface water claims in the Washington portion of the basin (PGG, 1995). These figures are useful as they depict the relative diversion rate and location of each diversion point. However these figures should be used with caution as the report states, “considerably more diversion occurs along the Walla Walla River and adjacent tributaries than is shown in Figure 3-3. This distribution of surface water claims (Figure 3-4) differs significantly from permits/certificates (PGG Pg. 13, 1995)”.

The OWRD and PGG (1995) figures are included in Attachment A.

WALLA WALLA RIVER DIVERSION MAP



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SOURCES:
1) Bridge Locations, Walla Walla County GIS, May 2002.
2) Dam Locations; Oregon Fish Passage Barrier Data Standard (OFPBDS), Oregon Department of Fish and Wildlife, Oregon Department of Transportation, US Bureau of Land Management October, 2009.
3) Diversions, Walla Walla Basin Watershed Council, 2010.
4) Rivers / Creeks, Marine Fisheries Commission and Washington State Department of Fish and Wildlife, Spetember, 1997.
5) Canals; Walla Walla Basin Watershed Council, 2010.
6) Gages; Orgegon Water Resources Department / USGS, 2010. Washington Department of Ecology, 2010.

References

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Gardena Farms Irrigation District #13 as amended from 2000. US Fish and Wildlife Service document No. FWS-PN-2731.

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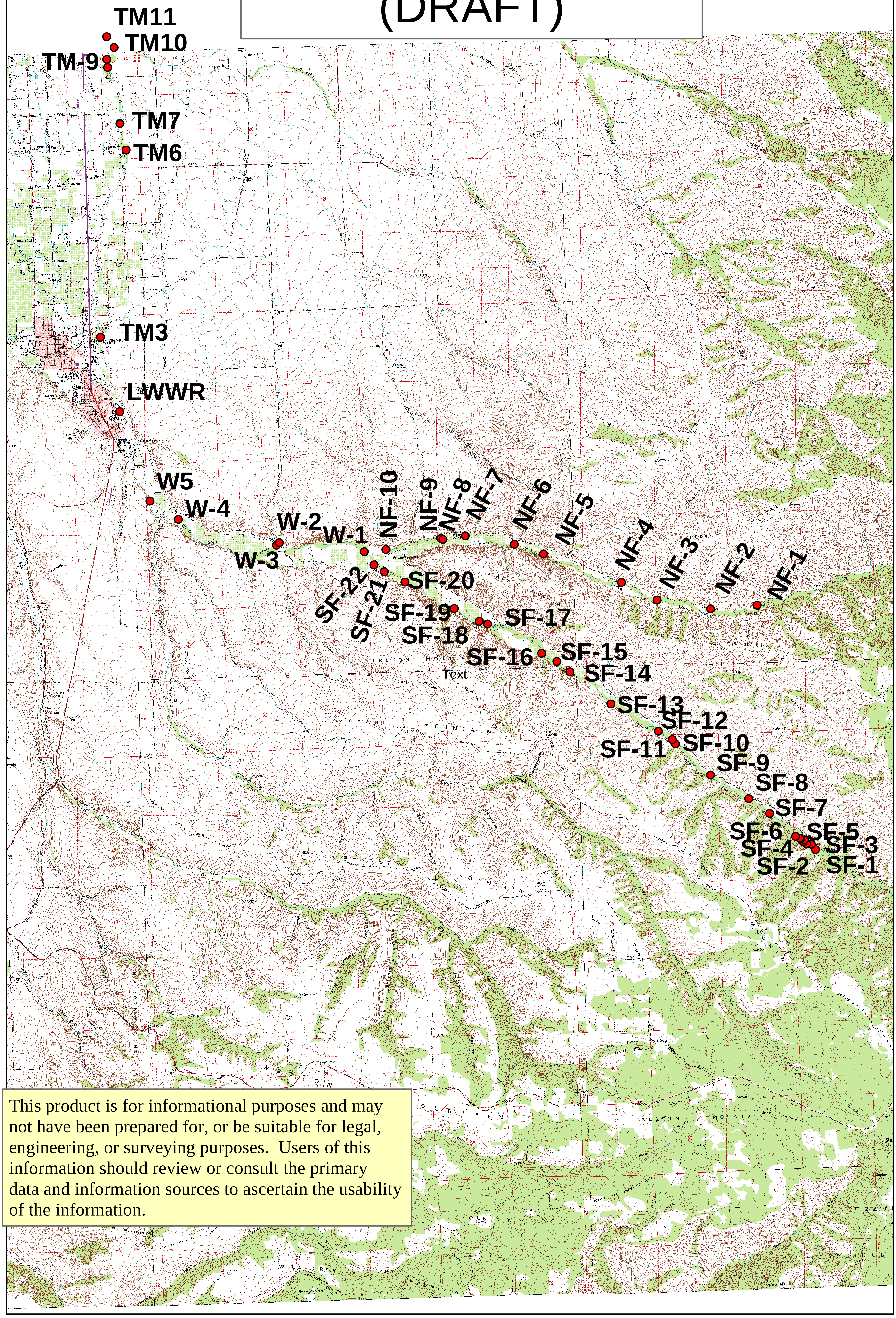
Attachment A

Oregon Point of Diversion (POD) Maps (OWRD, 2011)

Washington water right figures (PGG, 1995)

Walla Walla All PODs (DRAFT)



This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

\\GIS2\Arcview Projects\Walla Walla All PODs.mxd

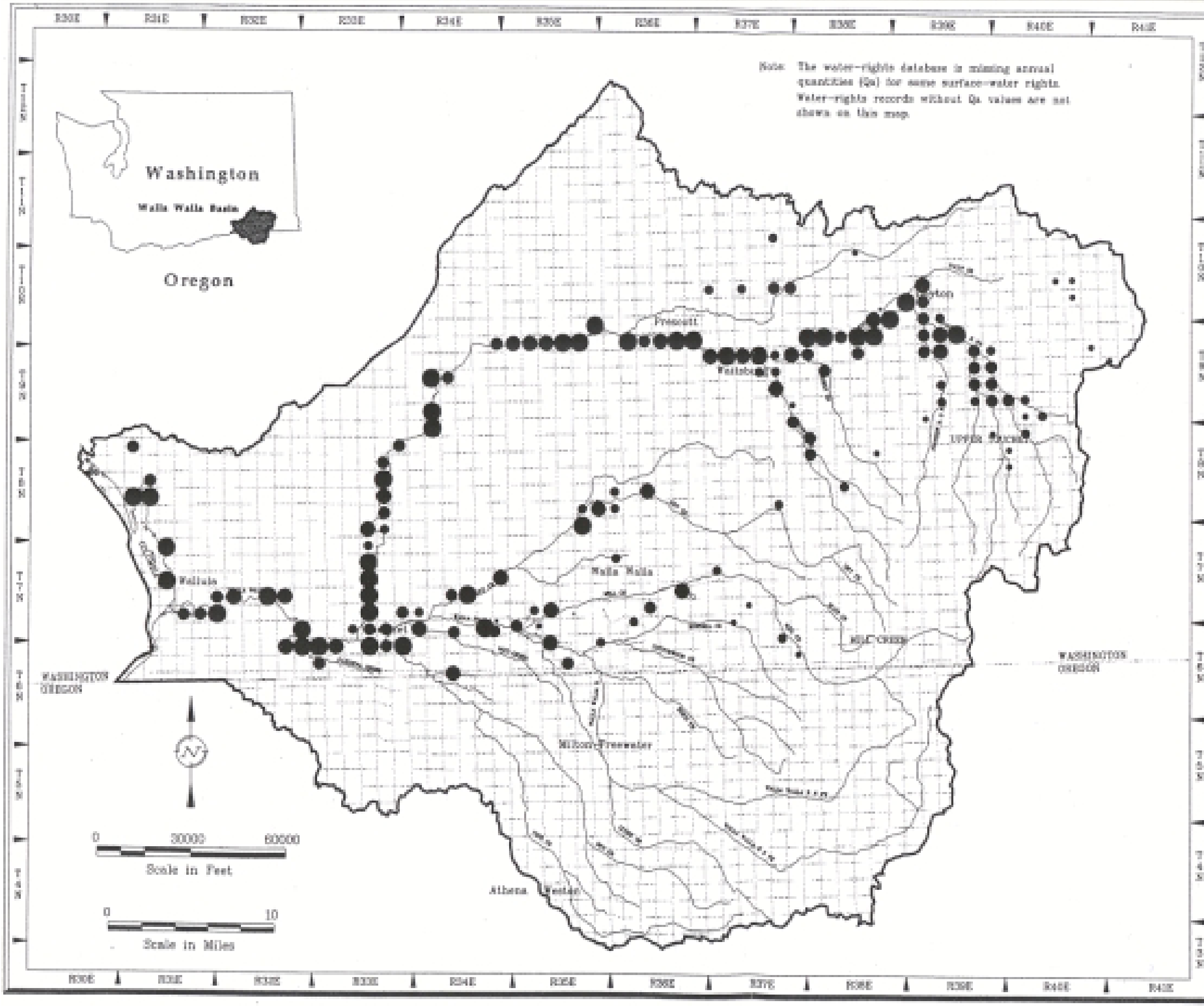


FIGURE 3-3

Distribution of Surface-Water Permits/Certificates

Initial Watershed Assessment Program
Walla Walla Basin

EXPLANATION

Aggregate Surface-Water Permits/Certificates Maximum Annual Quantities by Section

- 0 acre-ft/yr
- 0 to 10 acre-ft/yr
- 10 to 100 acre-ft/yr
- 100 to 500 acre-ft/yr
- 500 to 1000 acre-ft/yr
- Greater Than 1000 acre-ft/yr

- Stream, Major
- Section Lines
- Walla Walla Basin Boundary

DATA SOURCES

Washington State Department of Ecology, Water Resources Division

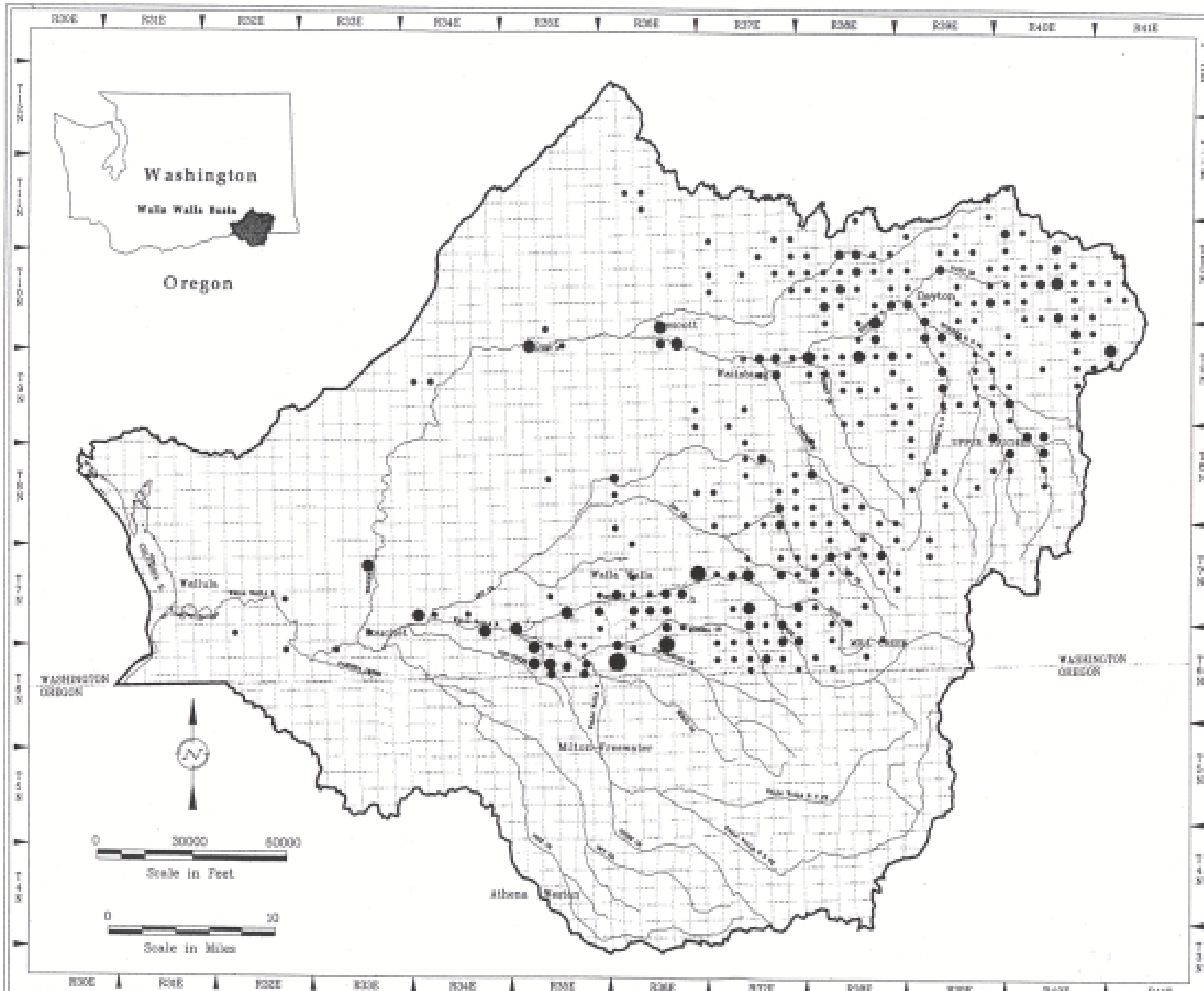


FIGURE 3-4

Distribution of Surface-Water Claims

Initial Watershed Assessment Program
Walla Walla Basin

EXPLANATION

Aggregate Surface-Water Claims
Maximum Annual Quantities by Section

- 0 acre-ft/yr
- 0 to 10 acre-ft/yr
- 10 to 100 acre-ft/yr
- 100 to 500 acre-ft/yr
- 500 to 1000 acre-ft/yr
- Greater Than 1000 acre-ft/yr

- Stream, Major
- Section Lines
- Walla Walla Basin Boundary

DATA SOURCES

Washington State Department of Ecology,
Water Resources Division

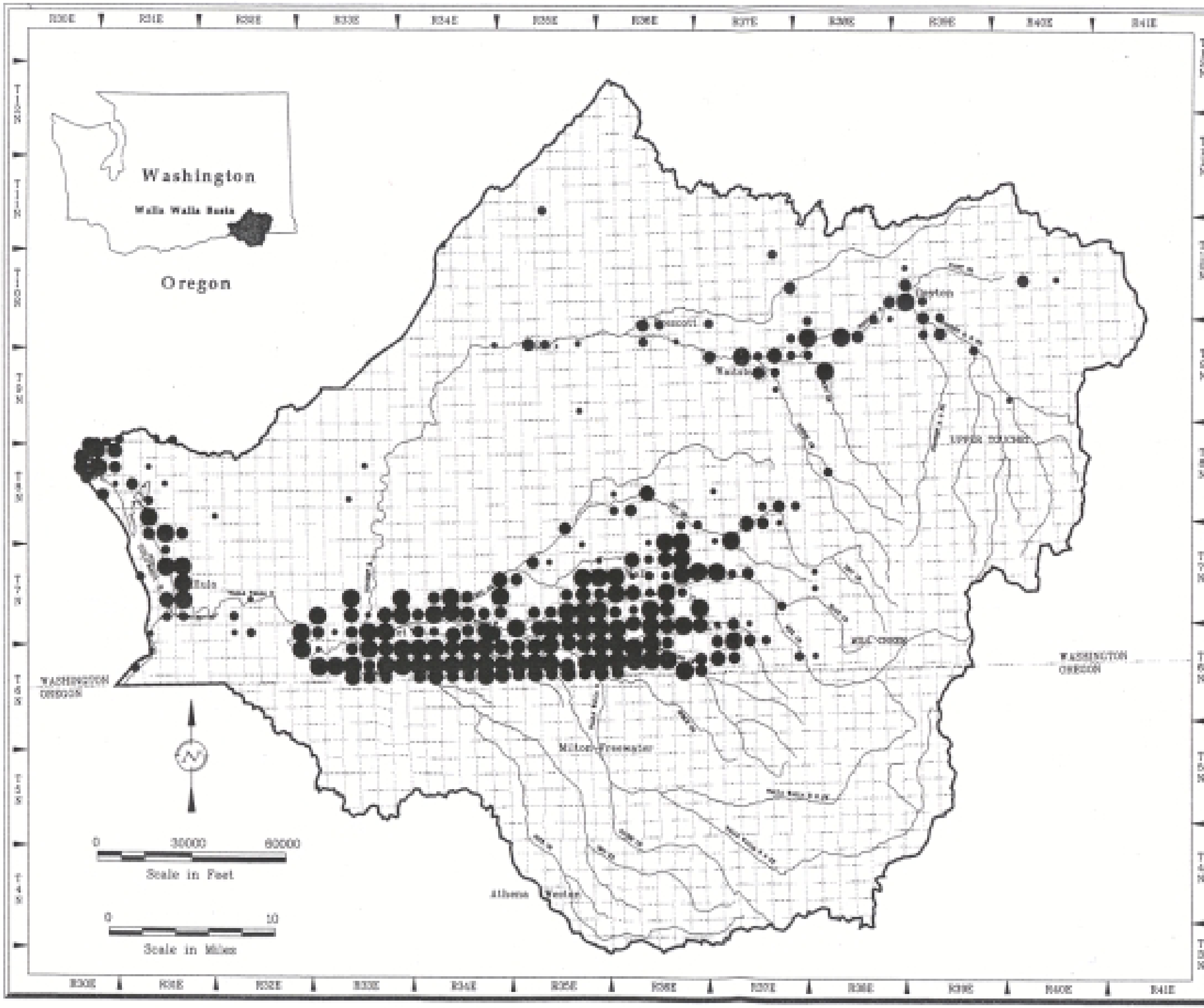


FIGURE 3-8

Distribution of Ground-Water Permits/Certificates

Initial Watershed Assessment Program
Walla Walla Basin

EXPLANATION

Aggregate Ground-Water Permits/Certificates
Maximum Annual Quantities by Section

- 0 acre-ft/yr
- 0 to 10 acre-ft/yr
- 10 to 100 acre-ft/yr
- 100 to 500 acre-ft/yr
- 500 to 1000 acre-ft/yr
- Greater Than 1000 acre-ft/yr

- Stream, Major
- Section Lines
- Walla Walla Basin Boundary

DATA SOURCES

Washington State Department of Ecology,
Water Resources Division

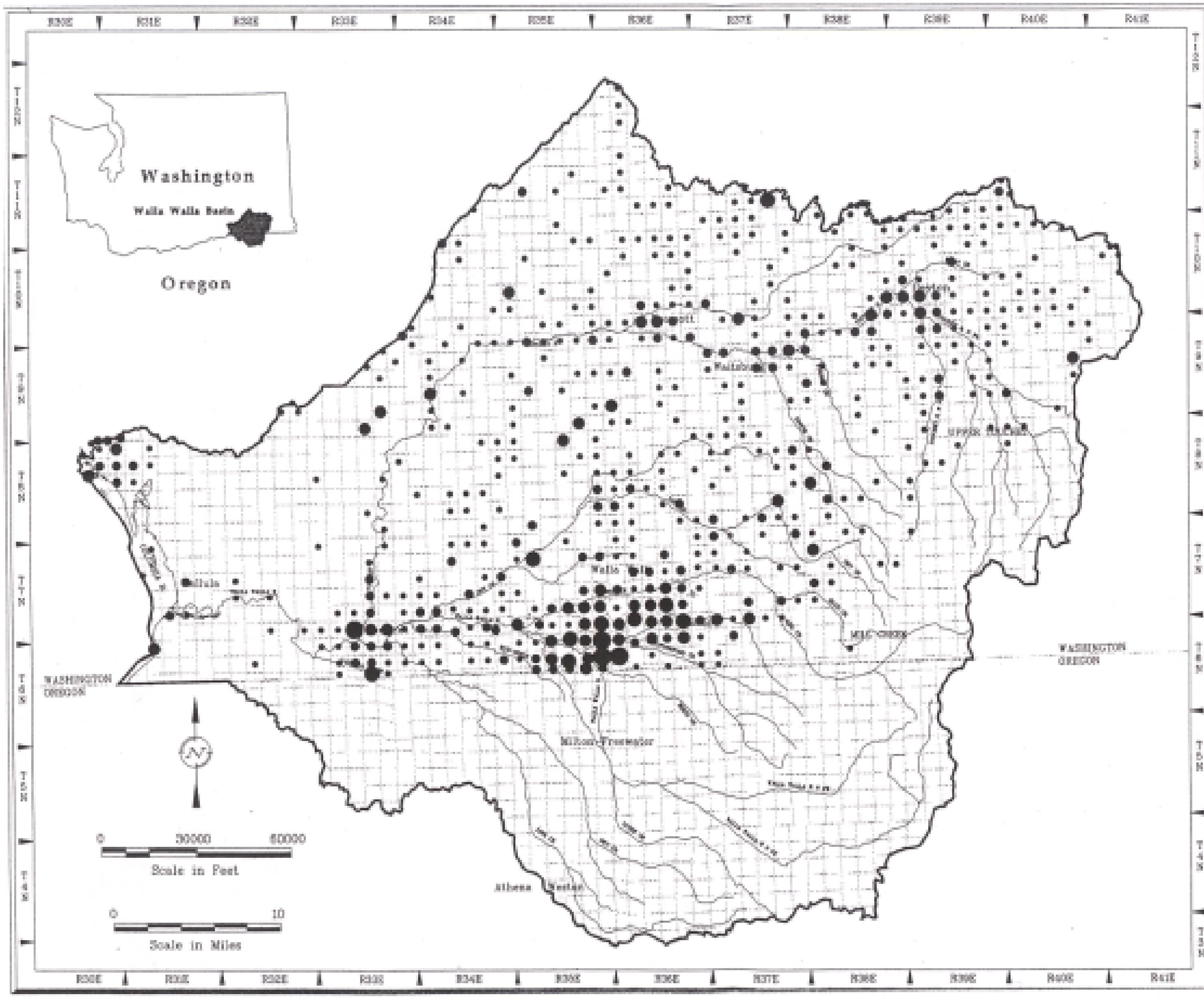


FIGURE 3-6

Distribution of Ground-Water Claims

Initial Watershed Assessment Program
Walla Walla Basin

EXPLANATION

Aggregate Ground-Water Claims
Maximum Annual Quantities by Section

- 0 acre-ft/yr
- 0 to 10 acre-ft/yr
- 10 to 100 acre-ft/yr
- 100 to 500 acre-ft/yr
- 500 to 1000 acre-ft/yr
- Greater Than 1000 acre-ft/yr

- Stream, Major
- Section Lines
- Walla Walla Basin Boundary

DATA SOURCES

Washington State Department of Ecology, Water Resources Division

Attachment B

WWRID, HBDIC, GFID Fact Sheets (WWWMP, 2010)

Walla Walla River Irrigation District (WWRID)
Fact Sheet

Background & History

- Formed in 1995 to Own, Operate, & Maintain 5 Irrigation Companies.
- Construction of ditches began in 1860's.
- 3212 assessed acres.
- 250 Accounts, 476 Parcels on Record.
- 5 Member Board of Directors (from 5 Sub-Districts)

Water Rights & Acreage

- Water Rights Held by Users (Except Pleasant View Rights Held by District)
- Divert Water as Requested up to 120 cfs (based on assessed acreage)
- 2004 Settlement Agreement: USFWS - 27 cfs until end of June, 25 cfs after June to be left in the River at Nursery Bridge
- Curtailment by priority date between WWRID & Hudson Bay District Improvement Company (HBDIC) with WWRID having more senior water right acres.
- Historically, rarely curtailed except Pleasant View
- 16.8 gpm / acre delivered

Diversion Dam, Intake, Fish Screens

- Diversion Dam located at Cemetery Bridge
- Concrete Construction with Inflatable Crest
- Diverts water into Little Walla Walla River
- Short Distance to Fish Screens
- Sponsorship by Tribes, Funding by BPA in 2000 for Fish Screen Improvement.
- NOAA Fisheries-compliant diversion facility

The "Frog"

- Splits water Between HBDIC & WWRID
- Undershot Gate (Submerged Orifice) for HBDIC
- Overshot Gate (Check Boards) for WWRID
- Approximately 1 ½ Miles from Diversion to the "Frog"

Other Diversions

- Milton Ditch - 8 cfs (Senior Rights) & 12 cfs (Junior Rights - mostly invalid due to 5 year non-use) from Walla Walla River (Consolidated to Little Walla Walla River system 2004)
- Stillman & Perkins Ditches – From Little Walla Walla River (Privately Operated)
- Smith Ditch - Not Active Due to Lack of Adequate Fish Screening.
- Eastside Canal Diversion – 9.6 cfs (Senior Rights) & 4.4 cfs (Junior Rights) from Walla Walla River

The Conveyance System

- 11 Main Canals: Milton, Smith, Pleasant View, Powell, Lydell, East Ford, West Ford, West Prong of West Crockett Branch, West Crockett Branch, East Crockett Branch, Eastside Pipeline
- 152,000 L.F. of Canals (~29 Miles)
- 25,000 L.F. Piped (~4.75 miles)
- Little Walla Walla River (considered a natural stream) is used to convey water

Operations

- Diversion based on water right
- Adjust +/- at Intake
- Adjust +/- at "Frog"
- Structures remain set and are adjusted proportionately by district

Irrigation & Crops

- 76% Sprinkler Irrigation (70% efficient)
- 22% Surface Irrigation (50% efficient)
- Apples make up 76%, Cherries 10%, Plum 9%, etc

System Efficiencies

- Little Walla Walla River Loss – Up to 14 cfs (combined loss, HBDIC & WWRID)
- Canal Seepage Loss – Up to 24 cfs
- Evaporation Loss – Up to 0.4 cfs
- Tailwater Loss – Up to 15 cfs in spring, approx 3 in summer

Hudson Bay District Improvement Company (HBDIC)
Fact Sheet

Background & History

- Formed in 1903 with 300 cfs notice to appropriate, later reduced to 100 cfs.
- Construction of ditches & structures followed.
- Most Construction completed by 1912.
- Set up as a Water Improvement District in 1952 under Oregon Revised Statute (ORS) 554.
- 5 Member Board of Directors

Water Rights & Acreage

- Water Rights Held by District
- Divert Water as Requested up to 130 cfs (Defined Right up to 200 cfs)
- 8.5 gpm / acre delivered
- For Irrigation of up to 8000 Acres (w/Pine Cr.) including ~ 80 Acres in Washington
- Curtailment by priority date between Walla Walla River Irrigation District (WWRID) and HBDIC, with WWRID having more Senior water right acres.
- 2004 Settlement Agreement: USFW - 27 cfs until end of June, 25 cfs after June to be left in the River at Nursery Bridge

Diversion Dam, Intake, Fish Screens

- Diversion Dam located at Cemetery Bridge
- Concrete Construction with Inflatable Crest
- Diverts water into Little Walla Walla River
- Short Distance to Fish Screens
- Sponsorship by Tribes, Funding by BPA in 2000 for Fish Screen Improvement.
- NOAA Fisheries-compliant diversion facility

The "Frog"

- Splits water Between HBDIC & WWRID
- Undershot Gate (Submerged Orifice) for HBDIC
- Overshot Gate (Check Boards) for WWRID
- Approximately 1 ½ Miles from diversion to "Frog"

Other Diversions

- Diversion at Nursery Bridge – Not Active Due to Lack of Adequate Fish Screening.
- Pine Creek Diversion – Used when Water is Available, up to 16.6 cfs. Primarily early season water used to offset main-stem diversion.

The Conveyance System

- 5 Main Canals: White, Barrett, Richardz, Huffman, Highline Canals
- 143,000 L.F. of Open Canals (~27 Miles)
- 40,000 L.F. Piped (~7.5 Miles)
- Some Creeks are used for Water Delivery
- Receive some Operational Spill from WWRID

Operations

- 24 hr. Notice from Water Users
- Requests Totaled for Diversion
- Adjust +/- at Diversion
- Adjust +/- at "Frog"
- Adjust Structures in System

Irrigation & Crops

- 99.5% Sprinkler Irrigation (70% efficient)
- Hay & Grain make up 66%, Apples 7%, Onions 6%, etc.
- ~50% Customers have Supplemental Wells

System Efficiencies

- Little Walla Walla River Loss – Up to 14 cfs (combined loss, HBDIC & WWRID)
- Canal Seepage Loss – Up to 28 cfs
- Evaporation Loss – Up to 0.3 cfs
- Tailwater Loss – Up to 8 cfs

Gardena Farms Irrigation District #13 (GFID)
Fact Sheet

Background & History

- Began as a privately owned irrigation system known as the Walla Walla Irrigation Company
- Construction of canals began in 1892.
- Fruit orchards were the primary crop for a number of years
- Became Gardena Farms in 1928
- 65 direct users
- 3 Member Board of Directors

Water Rights & Acreage

- Water rights owned by GFID with a priority date of 1892
- Irrigation water rights for 7,000 acres
- Water rights for diversion of 93.3 cfs (April 1 – July 1), 70 cfs (July 1 – October 1), 140 cfs (October 1 – April 1)
- 2004 Settlement Agreement: USFWS – 19 cfs January – June, 18 cfs July – December

Diversion Dam, Intake, Fish Screens

- Diverts water from the Walla Walla River
- Entire diversion at Burlingame Dam
- Intake located just upstream of Burlingame Dam – re-enforced concrete structure
- CTUIR-sponsored, BPA-funded fish ladder and screens commissioned in 1999
- NOAA Fisheries compliant diversion facility

Other Diversions

- 52 surface water rights and 85 groundwater rights located in close proximity to GFID action area.

The Conveyance System

- 3 major canals: Upper Canal and North and South Lateral Canals
- Majority of system consists of open channel, unlined canals – 22.14 miles, compared to 3.62 miles of piped canals.
-

Operations

- Inverted siphon used to cross Pine Creek Drainage – 1.44 miles long
- 3 Spillway discharge points: Pine Creek, North Lateral, and South Lateral
- Water diverted into system during two time periods per year – early March to mid-July and early October to late December

Irrigation & Crops

- 99.6% Sprinkler Irrigation (70% efficient)
- 0.3% Surface Irrigation (50% efficient)
- 81.3% spring wheat, alfalfa seed and alfalfa hay

System Efficiencies

- Canal Seepage Loss – Up to 24 cfs
- Evaporation Loss – Up to 0.32 cfs
- Tailwater Loss – Up to 6 cfs

Attachment C

Table of OWRD Water Rights

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1862	D13214	Smith, Ella	Watts, George	5-36-24-0201	NFWWR	Unnamed	3.6	0.14	NF-5
1862	D13274	Walden, Sarah	Kanyon, Donna	5-36-20-0600	WW- spring	Private	4.5	0.17	WW
1862	D12832	Kelly, Anna	Smith, Albert	5-36-20-0900	WWR	Spence	6.3	0.236	WW-2
1862	D13273	Walden, Sarah	Knight, Steven	5-36-20-0400	WWR	Spence	10.62 p	0.4	WW-2
1862	D12623	Day, J.H.	Knight, Steven	5-36-20-0500	WWR	Spence	7.52 p	0.28	WW-2
1862	D12623	Day, J.H.	Knight, Steven	5-36-20-0501	WWR	Spence	p		WW-2
1862	D13273	Walden, Sarah	Kanyon, Donna	5-36-20-0600	WWR	Spence	p		WW-2
1864	D12666	Mary Eubanks	Jerry Larson	6-35-13D-100	Tumalum	Hardin	38.22	1.43	TM10
1865	D12742	Harrington, Dean	Harris, Mabel	5-36-20-1090	WWR	Unnamed	18.5	0.69	WW-1
1865	D13131	Price, Albert	Kinsley, Cheryll & Dale	5-36-20-0700	WWR	Spence	3.89	0.146	WW-2
1868	D12629	Demaris, A.L.	Kelly, Virginia	5-36-21-0400	WWR	Demaris	1.07e	0.04	WW-1
1868	D12629	Demaris, A.L.	Demaris, Eugene	5-36-21-0390	WWR	Demaris	1.23e	0.046	WW-1
1868	D12629	Demaris, A.L.	Soper, William	5-36-21-0401	WWR	Demaris	17.76e	0.67	WW-1
1868	D12629	Demaris, A.L.	Sittel, Robert	5-36-21-0380	WWR	Demaris	3.74e	0.14	WW-1
1870	C80513	Rhuberg, Freda	Baker	5-36-26-0300,304	SFWWR	Rhuberg	12.2	0.458	SF-18
1870	T-8706	Rhuberg, Freda	Wells, Sam, Heidi	5-36-22-1500	SFWWR	Rhuberg	11.1	0.42	SF-19
1871	D12796	Huber, Harry	Boehm, Walter	5-36-22-1700	SFWWR	Unamed	2	0.075	SF-19
1872	D13263	Vancil, Melinda	King, Sherron	4-36-4,5-800	Couse Cr.	Private	10	0.375	C11
1872	D13270	Wagner, M.H.		5-36-21-702	spring	Pipe	STK		X
1872	D12919	City of Milton-Fre	City of Milton-Freewat	5-35-12AC-2000	WWR		1		WW
1872	D12635	Demaris, Leslie	Demaris, Merle	5-36-21-0201	WWR	Demaris	1.11	0.042	WW-1
1872	D12635	Demaris, Leslie	McKain/Custer	5-36-21-0200	WWR	Demaris	2.39	0.089	WW-1
1873	D13122	Pettit, J.N.	Hamby,William	5-36-7	WWR	Zell	2 p	0.075	WW-4
1873	D13122	Pettit, J.N.	Hamby,Williaml	5-36-18b-0200	WWR	Zell	3 p	0.112	WW-4
1873	D12704	Griton, C.B.	Lavezzo-Lennert D	5-36-18b-0500	WWR	Zell	5 p	0.188	WW-4
1873	D12769	Herpick, Minnie	Jonsson, Reynir	5-36-18b-1600	WWR	Zell	4.5	0.17	WW-4
1873	D13233	Steward, W.W.	Harrison, Opal	5-36-18c-0100	WWR	Zell	5	0.188	WW-4
1873	D13234	Steward, Charles	Martin, Gwendolyn	5-36-18c-1500	WWR	Zell	5.7	0.21	WW-4
1873	D13099	Norton, Geo.	Clutter, Gordon	5-36-18b-0701	WWR	Zell	13.3 p	0.5	WW-4
1873	D13104	Olinger, Anna	Valdes, Margie	5-36-18c-0700	WWR	Zell	4.7 p	0.176	WW-4
1873	D13219	Spence, Carrie	Fazio, John	5-36-07-1800	WWR	Zell	5.0p	0.188	WW-4
1873	D12696	Geiss, Peter	Bubar, Keven	5-36-18c-1200	WWR	Zell	8.1 p	0.3	WW-4
1873	D12696	Geiss, Peter	Arbogast Colton	5-36-18c-1201	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Birdwell, Benton	5-36-18c-1400	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Bond Joseph	5-36-18c-1208	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Botherton, Frances	5-36-18c-1210	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Harrison, Opal	5-36-18c-0100	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	McCormack Doyle	5-36-18c-1209	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Popplewell Harold	5-36-18c-1202	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Shaw Lyman	5-36-18c-1206	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Shaw Lyman	5-36-18c-1300	WWR	Zell	p		WW-4
1873	D12696	Geiss, Peter	Thacker, Alyss	5-36-18c-1203	WWR	Zell	p		WW-4

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1873	D12704	Girton, C.B.	Brunot, Ronald	5-36-18b-0601	WWR	Zell	p		WW-4
1873	D12704	Girton, C.B.	Brunot, Ronald	5-36-18b-0702	WWR	Zell	p		WW-4
1873	D12704	Girton, C.B.	Clutter, Gordon	5-36-18b-0600	WWR	Zell	p		WW-4
1873	D12704	Girton, C.B.	Clutter, Gordon	5-36-18b-0700	WWR	Zell	p		WW-4
1873	D13099	Norton, Geo.	Birdwell, Harold	5-36-18b-0900	WWR	Zell	p		WW-4
1873	D13099	Norton, Geo.	Jonsson, Reynir	5-36-18b-0901	WWR	Zell	p		WW-4
1873	D13104	Olinger, Anna	Anderson, Frank	5-36-18c-1000	WWR	Zell	p		WW-4
1873	D13104	Olinger, Anna	Carter Russ	5-36-18c-0701	WWR	Zell	p		WW-4
1873	D13104	Olinger, Anna	Carter Russ	5-36-18c-0800	WWR	Zell	p		WW-4
1873	D13104	Olinger, Anna	Humbert, Boyd	5-36-18c-1100	WWR	Zell	p		WW-4
1873	D13104	Olinger, Anna	Walker, Leroy	5-36-18c-0900	WWR	Zell	p		WW-4
1873	D13122	Pettit, J.N.	Bond, Joseph	5-36-18b-0300	WWR	Zell	p		WW-4
1873	D13122	Pettit, J.N.	Humbert, Robert	5-36-18b-0201	WWR	Zell	p		WW-4
1873	D13122	Pettit, J.N.	Humbert, Robert	5-36-18b-0202	WWR	Zell	p		WW-4
1873	D13122	Pettit, J.N.	Lavezzo-Lennert, D	5-36-18b-0203	WWR	Zell	p		WW-4
1873	D13122	Pettit, J.N.	Turner, Vida	5-36-18b-0400	WWR	Zell	p		WW-4
1873	D13219	Spence, Carrie	Cox, Ray	5-36-07-1900	WWR	Zell	p		WW-4
1873	D13219	Spence, Carrie	Dalgliesh, Donald	5-36-07-1901	WWR	Zell	p		WW-4
1873	D13219	Spence, Carrie	Dickson, Jon	5-36-07-1701	WWR	Zell	p		WW-4
1873	D13219	Spence, Carrie	Free, Ben	5-36-07-1902	WWR	Zell	p		WW-4
1873	D13219	Spence, Carrie	Valdes, Charles	5-36-07-1702	WWR	Zell	p		WW-4
1875	D13308	Winn, C.A.	Kerns, Ted	4-36-4-502	Couse Cr.		p		C13
1875	D13308	Winn, C.A.	Couse Cr Ranch	4-36-4-500	Couse Cr.		3.9p	0.146	C14
1875	D12760	Hellburg, Hans	Nickalatos, Dan	5-36-36-6800	SFWWR	Unnamed	6	0.225	SF-13
1875	D12810	Ingle, Samuel	Luke, Linda	5-36-20-0200	WWR	Spence	6.31 p	0.237	WW-2
1875	D12810	Ingle, Samuel	Sallie, Robert	5-36-20-0201	WWR	Spence	p		WW-2
1876	D13299	Williams, Irene	March, Herb	5-36-31-0500	Couse Cr.	Unnamed	4.5		C6
1876	D12694	Garred, J.D.	Bullock, Dan	5-36-22-1000	NFWWR	Bowlus	18.1	0.68	NF-8
1876	T-10019	CTUIR	CTUIR/BPA	4-37-05-0600	SFWWR	lateral	8.14	0.3	SF-11
1876	C76328	Powell, Cyrus	Ferner, Glen	5-36-18b-1601	WWR	Zell	(p)		WW-4
1876	C76328	Powell, Cyrus	Findley, Earnest	5-36-18b-1500	WWR	Zell	(p)		WW-4
1876	C76328	Powell, Cyrus	Inscore, Chester	5-36-18b-1300	WWR	Zell	0.44 p	0.016	WW-4
1876	C76328	Powell, Cyrus	Clark, Rod	5-36-18b-1501	WWR	Zell	10.84 p	0.41	WW-4
1876	D13281	Wallingford, Susan	Stocke, Nita	5-36-18b-0800	WWR	Zell	3.5 p	0.13	WW-4
1876	C76328	Powell, Cyrus	Richman, Darren	5-36-18b-1507	WWR	Zell	p		WW-4
1876	C76328	Powell, Cyrus	Calbrera, Nancy	5-36-18b-1508	WWR	Zell	p		WW-4
1876	C76328	Powell, Cyrus	Beyer, Suzanne	5-36-18b-1400	WWR	Zell	p		WW-4
1876	C76328	Powell, Cyrus	McCoy, Ron	5-36-18b-1505	WWR	Zell	p		WW-4
1876	C76328	Powell, Cyrus	Jepson, Kenneth	5-36-18b-1502	WWR	Zell	p		WW-4
1876	D13281	Wallingford, Susan	Birdwell, Harold	5-36-18b-0900	WWR	Zell	p		WW-4
1876	D13281	Wallingford, Susan	Werhan, Edwin	5-36-18b-1000	WWR	Zell	p		WW-4
1876	D13281	Wallingford, Susan	Werhan, Edwin	5-36-18b-1001	WWR	Zell	p		WW-4

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1877	D12908	Merrifield, John	Bullock, Lance	5-36-22-0900	NFWWR	Bowlus	8.8p	0.33	NF-8
1877	D12908	Merrifield, John	Hopper, Al	5-36-22-0800	NFWWR	Bowlus	p		NF-8
1877	D13218	Spence, A.	Robertson, Robert	5-36-17-4100	WWR	Spence	4.14	0.155	WW-2
1877	D12789	Hopson, W.C.	Bolen / Harris	5-36-20-0300	WWR	Spence	38.54 p	1.44	WW-2
1877	D12789	Hopson, W.C.	Bolen, Romeo	5-36-20-302	WWR	Spence	p		WW-2
1877	D12789	Hopson, W.C.	Garcia, Beth	5-36-20-0308	WWR	Spence	p		WW-2
1877	D12789	Hopson, W.C.	Hill, Elmer	5-36-20-0303	WWR	Spence	p		WW-2
1877	D12789	Hopson, W.C.	Jensen, Keith	5-36-20-0305	WWR	Spence	p		WW-2
1877	D12789	Hopson, W.C.	Maccarone, Gerald	5-36-20-301	WWR	Spence	p		WW-2
1877	D12789	Hopson, W.C.	Pureco, Jose	5-36-20-0307	WWR	Spence	p		WW-2
1877	D13218	Spence, A.	Krumbah, Russ	5-36-17	WWR	Spence	p		WW-2
1877	D13157	Richardson, M.	Langley, Richard	5-36-18c-0200	WWR	Zell	9.7(p)	0.36	WW-4
1877	D13157	Richardson, M.	Salyer, Harold	5-36-18c-0201	WWR	Zell	p		WW-4
1878	T10418	Cayuse Vineyards	Christophe Baron	5-36-21-1100	NFWWR	Lateral	3.6	0.135	NF-11
1878	C84124	Tribou, R.A.	Christophe Baron	5-36-22-0400	NFWWR	Lateral	10.5	0.39	NF-11
1878	D12575	Chapman, Robert	Wallace, Norman	5-36-25-1101,1104	SFWWR	Chapman	1.22e	0.046	SF-14
1878	D12575	Chapman, Robert	Stevens, Mike	5-36-25-1103	SFWWR	Chapman	1.53e	0.057	SF-14
1878	D12575	Chapman, Robert	Corfield/Rogers	5-36-25-0701,703	SFWWR	Chapman	3.42e	0.128	SF-15
1878	D12575	Chapman, Robert	Rogers, Glen	5-36-25-1000	SFWWR	Chapman	p		SF-15
1878	D12641	Dorothy, R.M.	Bullock, Lance	5-36-21-1000	SFWWR	Pump	27.2	1.02	SF-22
1879	C83361	State of Oregon	NA	5-35-12-SWNE	Tumalum		ISWR	0.075	TM
1880	D12555	Bradshaw, L.F.	Kelly, Sherry	5-36-24-0101	NFWWR	Unamed	6	0.225	NF-4
1880	D12787	Hopper	Truax, Keith	5-36-24-0500	NFWWR		1	0.04	NF-4
1880	IL-552	Hopper	Truax, Keith	5-36-24-0500	NFWWR		3	0.11	NF-4
1880	D12631	Demaris, C.E.	Harper land	5-36-22-0500, 700	NFWWR	Bowlus	7.2	0.27	NF-8
1880	D12634	Demaris, George		4-38-07	SFWWR	lateral	dom/stock		SF
1880	C81460	Zimmerman, Otto	Hopper, Alfred	5-37-31	SFWWR	Private	2	0.075	SF-10
1880	D13314	Zimmerman, Otto	BPA	4-37-5	SFWWR		3.3	0.124	SF-10
1880	T-9794	Robertson, David	Robertson, David	5-37-31-6100	SFWWR	Private	8.1	0.3	SF-12
1880	D12746	Harris,Claude	Hopper, Alfred	5-37-31-6001	SFWWR	Robinson	13	0.49	SF-12
1880	D13288	West, Sarah	Talbott, Susan	5-36-20-100	WWR		2.4	0.09	WW-3
1881	D12745	Harris, Claude	Ramsey, Dan	5-37-31-5700	SFWWR	unnamed	8.39	0.31	SF-13
1881	C80290	Harris, Clarence	unknown	5-36-21	SFWWR	Dorothy	0.17		SF-21
1881	C80289	Hopkins, Elmer	Oneill, Mark	5-36-21-0601	SFWWR	Dorothy	1.99	0.07	SF-21
1881	D13125	Pitzer, John	Sexton, Mark	5-36-21-0800	SFWWR	Dorothy	6	0.23	SF-21
1881	D12594	Cockburn, H.M.	Christianson, Stan	5-36-21-0900	SFWWR	Dorothy	9.4	0.35	SF-21
1881	D13090	Moss, C.J.	Sexton, Mark	5-36-21-0800	SFWWR	Dorothy	10.1	0.38	SF-21
1881	C80290	Harris, Clarence	McReynolds, R.	5-36-21-0502	SFWWR	Dorothy	1.08e	0.04	SF-21
1881	C80290	Harris, Clarence	Woodhall, Kevin	5-36-21-0602	SFWWR	Dorothy	2.25e	0.08	SF-21
1881	C80290	Harris, Clarence	Kelsay, Allen	5-36-21-0501	SFWWR	Dorothy	2.92e	0.109	SF-21
1881	C80291	Wagner, M.H.	Holdernestien, Tim	5-36-21-0700	SFWWR	Dorothy	9.68e	0.36	SF-21
1881	T-8437	Harris, Clarence	Stolz, Milo	5-36-21-0600	WWR	Demaris	3.58	0.134	WW-1

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1881	T-8437	Hopkins, Elmer	Stolz, Milo	5-36-21-0600	WWR	Demaris	6.01	0.225	WW-1
1881	T-8437	Wagner, M.H.	Stolz, Milo	5-36-21-0701	WWR	Demaris	7.02	0.26	WW-1
1882	D12556	Bradshaw, L.F.	Kelly, Pat	5-36-24-0100	NFWWR	Unnamed	2	0.075	NF
1882	D13146	Redden, M.	Cosper, Dale	4-37-09-1400	SFWWR	Unnamed	7.1	0.27	SF-7
1882	D13146	Redden, M.	Cosper, Dale	4-37-09-1500	SFWWR	Unnamed	2	0.075	SF-7?
1883	T-10019	CTUIR	CTUIR/BPA	4-37-05-0600	SFWWR	lateral	3.25	0.122	SF-11
1884	T-8822	Wallace, W.H.	Lewis, Floyd	5-36-22-1900	SFWWR	Holstein	3.05	0.114	SF-19
1884	C79897	Wallace, W.H.	Wrinkle, Linda	5-36-22-1902	SFWWR	Holstein	4.95	0.185	SF-19
1885	D12711	Graham, Ozro	Hopper, Al	5-36-22-0800	NFWWR	Bowlus	5	0.19	NF-8
1885	C80511	Gray, R.J.	Dombrosky, Chad	5-36-22-1502	SFWWR	Unamed	1	0.038	SF-18
1885	T-8822	Roloff, Helen	Lewis, Floyd	5-36-22-1900	SFWWR	Hopkins	3.55	0.133	SF-19
1885	C79898	Gray, R.J.	Wilcox, John	5-36-22-2100	SFWWR	Gray/Dem	10.45	0.392	SF-19
1885	T-8706	Gray, R.J.	Wells, Sam, Heidi	5-36-22-1500	SFWWR	Unnamed	11.6	0.435	SF-19
1885	D12619	Curl, William	Wheeler, Richard	4-37-4-400	SFWWR	Unnamed	5.15	0.19	SF-8
1885	C83361	State of Oregon	NA	5-35-12-SWNE	Tumalum		ISWR	0.101	TM
1885	D13235	Steward, Charles	Park, Alvin	5-36-18c-pub.	WWR	Steward-Ra	0.5	0.019	WW
1885	D12747	Harris, Claude	Bolen / Harris	5-36-20-0300	WWR	Spence	9.4 p	0.35	WW-2
1885	D12747	Harris, Claude	Bolen, Romeo	5-36-20-0302	WWR	Spence	p		WW-2
1886	C77006	State of Oregon	NA	5-35-01-NESW	Tumalum		ISWR	0.018	TM
1886	C77007	State of Oregon	NA	5-35-01-NESW	Tumalum		ISWR	0.04	TM
1887	D13216	Smith, Robert	Hopper, Alfred	5-37-31- 5900	SFWWR	Robinson	9.61	0.36	SF-12
1887	D13116	Paulsen, L.	Widner, Greg	5-36-25-0800	SFWWR	Unnamed	.9e	0.034	SF-15
1887	D13116	Paulsen, L.	Hopper	5-36-25-0801	SFWWR	Unnamed	5.1e	0.19	SF-15
1887	C80259	Powell, William	Elliot, Larry	5-36-22-1800	SFWWR	Unnamed	3.1	0.116	SF-18
1887	T-8561	Elliott, Larry	Baker, Bob	5-36-26-0800	SFWWR		6	0.225	SF-18
1887	D12797	Huber, Harry	Boehm, Walter	5-36-22-1700	SFWWR	Hopkins	1	0.038	SF-19
1887	C83361	State of Oregon	NA	5-35-12-SWNE	Tumalum		ISWR	0.121	TM
1888	D12828	Kelley, J.	Kelley, Pat	5-37-19-5400	NFWWR	Wallace 1	4.8	0.18	NF-3
1888	D12828	Kelley, J.	Sams, Carol	5-37-19-3700	NFWWR	Wallace 2	14.7	0.55	NF-4
1888	T-8479	Gross, Jimmy	Gross, Jim	4-37-10-2000	SFWWR	Roberts	0.87	0.03	SF-1
1888	C81171	Maling, Lucie		4-37-10	SFWWR	Roberts	1.93	0.072	SF-1
1888	D13161	Robinson, Guy	Widner, Greg	5-36-25-0800	SFWWR	Unamed	1.6e	0.06	SF-15
1888	D13161	Robinson, Guy	Hopper	5-36-25-0801	SFWWR	Unamed	2.5e	0.094	SF-15
1888	D12786	Hopkins, S.H.	Teneych, Shirley	5-36-23-1400	SFWWR	Hopkins	14.4e	0.54	SF-19
1888	D12786	Hopkins, S.H.	Teneych, Shirley	5-36-26-0600	SFWWR	Hopkins	6.87e	0.258	SF-19
1888	T-8509	Weatherman,Zelma	Weatherman, Zelma	4-37-10-2001	SFWWR	Roberts	0.67	0.025	SF-2
1888	T-8474	Pratt, Keith	Pratt, Keith	4-37-10-1900,1901	SFWWR	Roberts	1.24	0.046	SF-3
1888	T-8337	Sargent/Phinney	Sargent/Phinney	4-37-10-(1200,700)	SFWWR	Roberts	2	0.075	SF-5
1888	T-8337	Maling, Lucie	Ehart, John	4-37-10-(1400,1500)	SFWWR	Roberts	2.29	0.086	SF-5
1888	Decree	WWRID	See East Side list	See East Side list	Tumalum	Eastside		7.68	TM3
1889	D13100	Obert, Harry	Bales, Floyd	5-36-24-0290	NFWWR	Albrecht	1.5	0.056	NF-6
1889	D13277	Wallace, Roy	Scobal/Fry	5-36-23-0801	NFWWR	Unamed	4.1e	0.154	NF-6

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1889	D13277	Wallace, Roy	Lane, Dan & Dana	5-36-23-0903	NFWWR	Unamed	6.1e	0.229	NF-6
1889	D12530	Barnes, Benj.	Bullock, Dan	5-36-22-1200	NFWWR	Bowlus	13.9	0.52	NF-8
1890	D12920	City of Milton-Fre	City of Milton-Freewat	within City	WWR		mun/dom	7.24	WW
1890	D12635	Demaris, Leslie	Demaris, Merle	5-36-21-201	WWR	Demaris	2.07	0.077	WW-1
1890	D12635	Demaris, Leslie	McKain/Custer	5-36-21-200	WWR	Demaris	4.43	0.166	WW-1
1890	C12978	Henninger, George	York	5-35-13AA, tl.2000	WWR	Milton	2.9	0.11	WW-5
1891	D12829	Kelley, J.	Sams, Leland	5-37-29-5300	NFWWR		2.6		NF
1891	D12829	Kelley, J.	Sams, Delbert	5-37-29-5380	NFWWR		3.3		NF
1891	D12829	Kelley, J.	Sams, Delbert	5-37-29-5102	NFWWR	Bowlus 1	5.1	0.191	NF-1
1891	D12829	Kelley, J.	Sams, Delbert	5-37-29-5380	NFWWR	Kelley	3.9	0.146	NF-2
1891	D12829	Kelley, J.	Sams, Delbert	5-37-29-5300	NFWWR	Kelley	5.3	0.2	NF-2
1891	D13278	Wallace, Roy	Sams, Delbert	5-36-24-0400	NFWWR	Lateral	5.2	0.195	NF-4
1891	D12796	Huber, Harry	Boehm, Walter	5-36-22-1700	SFWWR	Unamed	6.5	0.24	SF-19
1891	T10219	Romsos, Wallace	Romsos, Wallace	4-37-10-500	SFWWR	Roberts	0.54	0.02	SF-6A
1891	T10220	Romsos, Donald	Romsos, Donald	4-37-10-400	SFWWR	Roberts	0.72	0.027	SF-6A
1891	T-8587	Brunson, Justin	Brunson, Justin, etal	4-37-10-401	SFWWR	Roberts	1.24	0.046	SF-6B
1891	D12637	Denny, A.C.		6-35-36C-(1400-1406)	Tumalum	Tumalum	6	0.225	TM2
1892	D13213	Smith, Ed	Hopper, Alfred	5-36-24-0300	NFWWR	Albrecht	11	0.412	NF-5
1893	D12830	Kelley, J.	Sams, Leland	5-37-30-5401	NFWWR	Wallace 1	4	0.15	NF-3
1893	D13306	Wilson, Margaret	Swiger, Ronald	5-36-23-0700	NFWWR	Unnamed	1	0.038	NF-6
1893	T-10019	CTUIR	CTUIR/BPA	4-37-05-0600	SFWWR	lateral	3.21	0.12	SF-11
1893	D12760	Hellburg, Hans	Nickalatos, Dan	5-36-36-6800	SFWWR	Unamed	8.33	0.31	SF-13
1893	D12629	Demaris, A.L.	Kelly, Virginia	5-36-21-0400	WWR	Demaris	.45e	0.017	WW-1
1893	D12629	Demaris, A.L.	Demaris, Eugene	5-36-21-0390	WWR	Demaris	.51e	0.019	WW-1
1893	D12629	Demaris, A.L.	Sittel, Robert	5-36-21-0380	WWR	Demaris	1.57e	0.059	WW-1
1893	D12629	Demaris, A.L.	Soper, William	5-36-21-0401	WWR	Demaris	7.47e	0.28	WW-1
1894	D13101	Obert, O.W.	Swiger, Ronald	5-36-23-0700	NFWWR	Obert	.75e	0.028	NF-6
1894	D13101	Obert, O.W.	Tate, Leroy	5-36-23-0800	NFWWR	Obert	1.45e	0.054	NF-6
1894	D13127	Poulsen	Huber	5-36-26-1004	SFWWR	Unnamed	6.8	0.255	SF-17
1894	D12797	Huber, Harry	Boehm, Walter	5-36-22-1700	SFWWR	Hopkins	5.4	0.2	SF-19
1894	D13172	Ross, J.B.	Hopper/Jensen	5-36-22-1600	SFWWR	E & W	8.5	0.32	SF-19
1894	C83361	State of Oregon	NA	5-35-12-SWNE	Tumalum		ISWR	0.038	TM
1894	D12667	Mary Eubanks	Jerry Larson	6-36-18-SWNW	Tumalum	Hardin	10	0.375	TM10
1894	D12637	Denny, A.C.		6-35-36C-(1400-1406)	Tumalum	Tumalum	2.5	0.094	TM2
1894	T9967	Thomas Sallee	Matthew Erlandson	5-35-13	WWR	pump blw MD	4.5	0.11	WW-6
1895	C84974	Shumway Conserv	Shumway Conserv	4-36-6-1400,5-36-31-700	Couse Cr.	Shumway	24.3	0.91	C7
1895	D13188	Schiller, J	Morris, Albert	5-36-23-1200	NFWWR	Old Bowlus	3.1	0.116	NF-7
1895	D12798	Huber, John	Tem c/o Bullock	5-36-23-1000	NFWWR	Unnamed	6.1	0.229	NF-8
1895	C83295	State of Oregon	NA	part of reach-see WW2	Tumalum		ISWR	0.1	TM
1895	D13142	Ransom, F.P.	Jorgenson	5-36-18c-0300	WWR	Marie Dori	10.2 p	0.38	WW
1895	D13142	Ransom, F.P.	City of M. F.	5-36-18c-0600	WWR	Marie Dori	p		WW
1895	D13142	Ransom, F.P.	Gunnels, John	5-36-18c-0400	WWR	Marie Dori	p		WW

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1895	D12751	Harris, H.	Harris, Mabel	5-36-20-1090	WWR	Harris	10.4	0.39	WW-1
1895	D12627	Demaris, Arch.	Demaris, Eugene	5-36-21-0300	WWR	Demaris	15.1	0.566	WW-1
1895	C83296	Harris, H.	Garriott	5-36-17-4000	WWR	Spence	3.9	0.146	WW-2
1895	C83296	Harris, H.	Lampson, Clark	5-36-18-4300	WWR	Spence	11.7	0.439	WW-2
1895	C83126	State of Oregon	NA	reach of ISWR (varies)	WWR		ISWR	0.7	WW-2
1895	C83296	Harris, H.	Harris, Mabel	5-36-18-4500	WWR	Spence	p		WW-2
1897	C84976	Sams, Jasper	Troyer	5-36-31-0400	Couse Cr.	Fred Sams	3.3	0.124	C6
1897	C84977	Howard, Joan	Howard, Joan	5-36-31-0200	Couse Cr.	pump	3.7	0.139	C5
1897	D13307	Wilson, Wilbur	Bullock, Dan	5-36-23-0600	NFWWR	Unnamed	0.7	0.026	NF-6
1897	D12712	Graham, Ozro	Bullock, Dan	5-36-23-0600	NFWWR	Direct	2.6	0.098	NF-6
1897	D12834	Kelly, W.H.	Bullock, Dan	5-36-23-1000	NFWWR	Bowlus	5	0.188	NF-8
1897	D12833	Kelly, W.H.	Afdahl, Brian	5-36-23-0900	NFWWR	Private	3.9	0.146	NF-9
1897	T9121	WWRID	See East Side list	See East Side list	Tumalum	Eastside		0.54	TM3
1898	D12693	Garred, Charles	Kruse	5-36-25-0401	SFWWR	Private	6.0,p	0.225	SF-16
1898	D12693	Garred, Charles	Denton/Mason	5-36-25-0400	SFWWR	Private	p		SF-16
1898	D12693	Garred, Charles	Trommald, John	5-36-25-0402	SFWWR	Private	p		SF-16
1898	C77006	State of Oregon	NA	5-35-01-NESW	Tumalum		ISWR	0.018	TM
1898	Decree	WWRID	See East Side list	See East Side list	Tumalum	Eastside		3.42	TM3
1899	D12538	Betts, Harry M		5-35-1BB	Tumalum	Tumalum	3	0.11	TM2
1900	D12598	Cockburn	Danforth	5-36-31-190, 191	Couse Cr.	Shumway-Co	8.6	0.322	C5
1900	D13209	Shumway, A.R.	Shumway, Leona	5-36-30-5600	Couse Cr.	Shumway	28.8e	1.05	C5
1900	D13209	Shumway, A.R.	March, Herb	5-36-30-5501	Couse Cr.	Shumway	8e		C5
1900	T-10019	CTUIR	CTUIR/BPA	4-37-05-0500	SFWWR	laterals	1.63	0.061	SF-11
1900	D12633	Demaris, C.E.	Wilcox	5-36-22-2100	SFWWR	Hayton	4.6	0.172	SF-19
1900	C81536	State of Oregon	NA	5-35-01- NENW	Tumalum		ISWR	0.027	TM
1901	D12629	Demaris, A.L.	Kelly, Virginia	5-36-21-0400	WWR	Demaris	.13e	0.005	WW-1
1901	D12629	Demaris, A.L.	Demaris, Eugene	5-36-21-0390	WWR	Demaris	.154e	0.006	WW-1
1901	D12629	Demaris, A.L.	Sittel, Robert	5-36-21-0380	WWR	Demaris	.469e	0.017	WW-1
1901	D12629	Demaris, A.L.	Soper, William	5-36-21-0401	WWR	Demaris	2.22e	0.083	WW-1
1902	D13178	Rhuberg, Thomas	Huber	5-36-26-1004	SFWWR	Hopkins	0.8	0.03	SF-17
1902	D13178	Rhuberg, Thomas	Baker, Bob	5-36-26-0304	SFWWR	Hopkins	5.9	0.22	SF-18
1902	C79898	Gray, R.J.	Nelson, Leroy	5-36-22-2101,2102,2103	SFWWR	Gray	6.9	0.259	SF-20
1902	D12921	City of Milton-Fre	City of Milton-Freewat	within City	WWR		power	82	WW
1903	CW-38	HBIC		5-35-01- NENW	Tumalum		ISWR	9.61	TM
1903	C77006	State of Oregon	NA	5-35-01-NESW	Tumalum		ISWR	0.04	TM
1903	C77007	State of Oregon	NA	5-35-01-NESW	Tumalum		ISWR	0.049	TM
1904	D13224	Staley, T.A.		5-35-01BB-blk U&T	Tumalum	Tumalum	3	0.113	TM2
1905	D12831	Kelley, J.	Sams, Leland	5-37-30-5401	NFWWR	Wallace	4.2		NF
1905	D12831	Kelley, J.	Sams, Leland	5-37-30-5401	NFWWR	Wallace 1	2.7	0.1	NF-3
1905	D12575	Chapman, Robert	Wallace, Norman	5-36-25-1101,1104	SFWWR	Chapman	2.77e	0.104	SF-14
1905	D12575	Chapman, Robert	Stevens, Mike	5-36-25-1103	SFWWR	Chapman	3.47e	0.13	SF-14
1905	D12575	Chapman, Robert	Corfield/Rogers	5-36-25-0701,703	SFWWR	Chapman	7.75e	0.291	SF-15

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
1905	D12575	Chapman, Robert	Rogers, Glen	5-36-25-1000	SFWWR	Chapman	p		SF-15
1905	D13187	Ernest Scherich		5-35-01BD-2400	Tumalum		2.81		TM1
1905	D12880	McDonald, Annie	Kilmer, ODOT	6-35-36B-400,490	Tumalum	Tumalum	3.31	0.124	TM2
1906	T-9481	John & Jane Mauer	Ron Robins	6-35-24A-502	Tumalum	pump	3.5	0.13	TM7
1906	T-9481	John & Jane Mauer	John Mauer	6-35-24A-513	Tumalum	pump	5.5	0.21	TM7
1906	C80904	NW Land Bank	et.al	6-35-24A-SWNE,NWSE	Tumalum		24.86	0.93	TM8
1906	D12635	Demaris, Leslie	Demaris, Merle	5-36-21-201	WWR	Demaris	3.02	0.113	WW-1
1906	D12635	Demaris, Leslie	McKain/Custer	5-36-21-200	WWR	Demaris	6.48	0.243	WW-1
1906	D13218	Spence, A.	Robertson, Robert	5-36-17-4100	WWR	Spence	1.86 (p)	0.07	WW-2
1906	D13218	Spence, A.	Krumbah, Russ	5-36-17	WWR	Spence	p		WW-2
1907	D13279	Wallace, Roy	Sams, Delbert	5-36-24-0400	NFWWR	Unamed	2.5	0.094	NF-4
1907	D12799	Huber, John	Bullock, Dan	5-36-23-1000	NFWWR	Unnamed	3.3	0.124	NF-8
1907	D13127	Poulsen	Huber	5-36-26-1004	SFWWR	Unamed	0.7	0.026	SF-17
1907	D13127	Poulsen	Daugherty	5-36-26-1000	SFWWR	Pump	1.3	0.049	SF-17
1907	D13289	West, Sarah	Strickland, S.	5-36-21-0101	WWR	Spence	2	0.075	WW-2
1908	D12712	Graham, Ozro	Bullock, Dan	5-36-23-0600	NFWWR	Direct	2	0.075	NF-6
1908	D13102	Obert, O.W.	Smith, James	5-36-23-0400	NFWWR	Obert	2.3	0.086	NF-6
1908	D13216	Smith, Robert A.	Hopper, Alfred	5-37-31-5900	SFWWR	Robinson	2.5	0.094	SF-12
1908	D12745	Harris, Claude	Ramsey, Dan	5-37-31-5700	SFWWR	Unnamed	2.9	0.109	SF-13
1908	D12693	Garred, Charles	Denton/Mason	5-36-25-0400	SFWWR	Private	7.0,p	0.262	SF-16
1908	D12629	Demaris, A.L.	Kelly, Virginia	5-36-21-0400	WWR	Demaris	0.346	0.013	WW-1
1908	D12629	Demaris, A.L.	Demaris, Eugene	5-36-21-0390	WWR	Demaris	0.398	0.015	WW-1
1908	D12629	Demaris, A.L.	Sittel, Robert	5-36-21-0380	WWR	Demaris	1.21	0.045	WW-1
1908	D12629	Demaris, A.L.	Soper, William	5-36-21-0401	WWR	Demaris	5.74	0.215	WW-1
1908	D13220	Spence, Carrie	Stock Nita	5-36-18b-101	WWR	Zell	0.74	0.028	WW-4
1909	D13213	Smith, Ed	Hopper, Alfred	5-36-24-0300	NFWWR	Albrecht	0.5	0.019	NF-5
1909	D12619	Curl, William	Wheeler, Richard	4-37-4-400	SFWWR	Roberts	3.55	0.133	SF-8
1909	D12790	Hopson, W.C.	Bolen/Harris	5-36-20-0300	WWR	Spence	6.86	0.257	WW-2
2/1/1909	D12712	Graham, Ozro	Bullock, Dan	5-36-23-0600	NFWWR	Direct	2.5	0.094	NF-6
2/1/1909	D13304	Wilson, J.W.	Bullock, Dan	5-36-23-0600	NFWWR	Lateral	2.5	0.094	NF-6
3/25/1912	C76779	State of Oregon	NA	5-35-12-SWNE	Tumalum		ISWR	0.012	TM
7/24/1912	T9121	WWRID	See East Side list	See East Side list	Tumalum	Eastside		1.16	TM3
3/18/1916	P2898	Jenkins, CC		6-35-36C-1600	Tumalum	Tumalum	4	0.05	TM2
8/18/1917	P3606	Wagner, John		6-35-36C-(1200-1301)	Tumalum	Tumalum	0.45	0.01	TM2
3/22/1919	P4031	Sams, F.Z.	March, Herb	5-36-31-0500	Couse Cr.		11	0.13	C6
10/26/1922	P5675	Cockburn/Shumway	Danforth	5-36-31-0190	Couse Cr.		10p	0.125	C4
10/26/1922	P5675	Cockburn/Shumway	Shumway	5-36-30-5600	Couse Cr.		32e, p	0.4	C4
10/26/1922	P5675	Cockburn/Shumway	March, Herb	5-36-30-5501	Couse Cr.		8e, p	0.1	C4
05/21/1923	P5885	Asa A. Demaris	Drive In Theatre	6-35-25-SESW	Tumalum	Loundigan	5	0.06	TM4
6/14/1923	P5928	Steward, Charles	Gunnels, John	5-36-18c-0490	Couse Cr.		10 p	0.1	C1
6/14/1923	P5928	Steward, Charles	Luisis, Eugene	5-36-18c-1800	Couse Cr.		p		C1
6/14/1923	P5928	Steward, Charles	Powell, Walt	5-36-18c-0500	Couse Cr.		p		C1

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
6/29/1923	P5945	Spence, Carrie	Fazio, John	5-36-07-1800	WW- waste&sp		4.0 (p)	0.05	WWZ
6/29/1923	P5945	Spence, Carrie	Cox, Ray	5-36-07-1900	WW- waste&sp		p		WWZ
6/29/1923	P5945	Spence, Carrie	Dalgliesh, Donald	5-36-07-1901	WW- waste&sp		p		WWZ
6/29/1923	P5945	Spence, Carrie	Dickson, Jon	5-36-07-1701	WW- waste&sp		p		WWZ
6/29/1923	P5945	Spence, Carrie	Free, Ben	5-36-07-1902	WW- waste&sp		p		WWZ
6/29/1923	P5945	Spence, Carrie	Valdes, Charles	5-36-07-1702	WW- waste&sp		p		WWZ
12/8/1924	P6605	Shumway, A.R.	Shumway	5-36-31-700	Couse Cr.		9	0.11	C8
12/8/1924	P6605	Shumway, A.R.	Shumway	5-36-5, 6-1400	Couse Cr.		13	0.17	C8
7/1/1925	P7067	Betts, HM		5-35-1BB	Tumalum	Tumalum	3	0.04	TM2
9/2/1926	C15559	City of Milton	City of M-F	5-35 & 5-36	SFWWR		Mun & elec	56.3	SF
10/4/1927	C7832	Henninger, George	York	5-35-13AA, tl.2000	WWR	Milton	1.5	0.02	WW-5
1/9/1928	P8274	Harris, Geo.	Woodhall	5-36-26-1300,1301	SFWWR		2.5e	0.03	SF-16
1/9/1928	P8274	Harris, Geo.	Wheeler	5-36-26-1400	SFWWR		5.0e	0.06	SF-16
12/22/1928	P8844	Graham, Orzo	Dan Bullock		NFWWR		3	0.04	NF-4
6/9/1930	P9686	Lackey, Gleaves		6-35-25C-2100,2200,02	Tumalum		5	0.06	TM4
3/1/1934	P11195	Girton, C.B.	Lavezzo-Lennert, D	5-36-18b-0500	drain/slou		2.8p, 5s	0.1	Y
3/1/1934	P11195	Girton, C.B.	Brunot, Ronald	5-36-18b-0601	drain/slou		p		Y
3/1/1934	P11195	Girton, C.B.	Brunot, Ronald	5-36-18b-0702	drain/slou		p		Y
3/1/1934	P11195	Girton, C.B.	Clutter, Gordon	5-36-18b-0600	drain/slou		p		Y
3/1/1934	P11195	Girton, C.B.	Clutter, Gordon	5-36-18b-0700	drain/slou		p		Y
8/24/1934	P11379	Garred, Irene	Kruse	5-36-25-0401	SFWWR	Canyon Flu	3	p	SF-16
8/24/1934	P11379	Garred, Irene	Denton/Mason	5-36-25-0400	SFWWR	Canyon Flu	9	0.14	SF-16
3/7/1935	P11582	Chapman, Robert	Brinker, Sam	5-36-25-0700	SFWWR		7.5	0.062	SF-16
7/22/1935	P11785	Rotary Club	Umatilla County	4-37-10	SF- spring		domestic	0.13	XS
5/27/1936	P12462	Harris, Laura	Harris, Mabel	5-36-20-1090	WW- waste		15s	0.5	Z
6/19/1939	P13830	Umatilla Nat. For.	UNF	4-38-21	SF- spring		domestic	0.02	XS
3/1/1941	P14775	Obert, Harry	Bales, Floyd	5-36-24-0290	NFWWR		3.5	0.13	NF-6
5/20/1942	P15279	Phelps, Mrs Frank		5-35-01BA-400	Tumalum	Tumalum	3	0.113	TM2
11/14/1942	P15398	Diggins, M.	Felton	4-36-4-701	Couse Cr.	Pump	3.2	0.12	C12
2/14/1946	P16793	Harrington	Kinsley, Cheryll & Dale	5-36-20-0700	WW- spring		0.9	0.034	WW
2/14/1946	P16794	Day, J.H.	Boehm, Walter	5-36-22-1700	WW- waste		3	0.12	Z
3/5/1951	P20516	Frazier, Lela	Everett Robert	4-37-25-5000	SF- spring		domestic	0.01	XS
7/2/1957	P26322	Harris, Mabel	Kelly, Pat	5-36-20-1090	spring		.9, stk, d	0.025	X
1/10/1958	P25298	Reynolds, Levi	Holdernestein, Tim	5-36-21-700	spring		(p)	0.01	X
1/10/1958	P25298	Reynolds, Levi	Waters, Clair	5-36-21-0800	spring		Dom/Stk p		X
1/16/1959	C76779	State of Oregon	NA	5-35-12-SWNE	Tumalum		ISWR	0.023	TM
04/25/1960	C33395	Robert Still	et. al.	6-35-24A-SWNE,NWSE	Tumalum		46.06(S)	1.01	TM8
11/24/1965	P31079	WWRID	See East Side list	See East Side list	Tumalum	Eastside		0.75	TM3
1/23/1967	P32302	Barnett Rug	Barnett Rugg	5--35-25,26	Couse Cr.		355.3	2.2	C3
10/26/1970	P35667	Morris, Lyle	Luisi Truck Lines	5-36-18c-1800	Couse Cr.		7.5	0.09	C1
4/7/1972	P36847	Ten Eyck, Robert	Afdahl, Brian	5-36-23-0900	NF- spring		domestic	3gpm	XN
10/5/1973	P38734	Allison, Thomas	Hague, Kenneth	4/38/30-401	SF- spring	spring#2	domestic	0.011	XS

Priority date	Water right	Water right name	Property owner	Location	Source	Ditch	Acres	Rate	POD
10/5/1973	P38734	Allison, Thomas	Wright, F.A.	4/38/30-402	SF- spring	spring#1	domestic	0.01	XS
1/21/1977	C82171	City of M-F	City of M-F	6-35-31	WWR	Milton	96.2	3.6	WW-5
1/21/1977	C82170	Key-Wallace	Key Bros.	6-35-31, 5-35-6	WWR	Milton	192.3	5.16	WW-5
2/2/1977	P41606	Blue Mt. Camp			CC- spring	spring#1&2	domestic	0.03	XC
2/9/1977	P41614	Julius Scofield			CC- spring	spring#2	comercial	15gpm	XC
04/29/1977	C66683	Bud Bier	Carl Anderson	6-35-13D-400+	Tumalum		54.6(S)	0.66	TM9
8/28/1978	P43653	Blue Mt. Camp			CC- spring	spring 1&2	domestic	0.005	XC
8/17/1979	P44527	Corwin, James		4/37/25	SF- spring		domestic	0.01	XS
4/9/1980	C82471	Morris, Albert	Morris, Albert	5-36-23-1200	NF- un str		1.6	0.06	NF
8/12/1981	C82224	Bullock, Wallace	Bullock, Lance	5-36-22-0600	SFWWR		10	0.38	SF-22
6/17/1982	P48783	US Forest Service	US Forest Service	4/38/27	SF- spring		stock,wild	0.004	XS
10/3/1983	P50492	UMAT NAT.F.S.	UMAT.NAT.F.S.	5-38-02	NFWWR	Saddle Sp	stock	0.004	X
10/7/1983	P48317	Broadway Finance	Lampson, Clark	5-36-20-4300	WWR	Spence	2.3(S)	0.086	WW-2
11/3/1983	C59839	State of Oregon		5-36-22-LWW	WWR		ISWR	var.	WW
12/5/1984	C82510	James Ingals	James Ingals	5-36-22	NF- pond		2.8	0.06	NF
12/5/1984	P49268	Bobbit, Ralph	Ingles, Norma	5-36-22-801	NF- pond		p	0.06	X
4/18/1985	C82510	James Ingals	James Ingals	5-36-22	NF- pond		p	0.04	NF
4/18/1985	P49268	Bobbit, Ralph	Ingles, Norma	5-36-18-801	NF- pond		5	0.13	X
6/23/1987	C82208	E. Shumway Banks	E. Shumway Banks	4-36-6-1400	Couse Cr.		8.2	0.1	C7
9/18/1987	C86341	Banks/Alderson	Banks/Alderson	5-36-19-4703	Couse Cr	Pumps	21.9	0.256	C2
8/21/1990	C72987	OWRD			Couse Cr.		ISWR	vary	C
8/21/1990	C72649	OWRD			NFWWR		ISWR	varie	NF
8/21/1990	C72648	OWRD		5-39-30-mouth	SFWWR		ISWR	varie	SF
1/26/1996	P53028	BPA	Wolcot, Marian	4-37-5/5-37-32	SFWWR		fish	19.4	SF-11
1/12/1998	P53618	Walter Humbert	Beverly Eiffert	6-35-24D-1100	Tumalum		7.0(F)	0.78-	TM5
1/21/2003	R13590	Banks/Alderson	Banks/Alderson	5-36-19-4703	Couse Cr.	pump	Reservoir	none	C2
1/21/2003	R13591	Banks/Alderson	Banks/Alderson	5-36-19-4703	Couse Cr.	pump	Reservoir	none	C2
8/4/2008	R14697	Steiner, Matthew	Steiner, Matthew	5-36-22	NFWWR	pump	5.0 af		NF-10

Attachment D

Table of WDOE Water Rights for the Walla Walla River

KEY_MAIN	DOCUMENT NUMBER	DOCUMENT TYPE	PRIORITY DATE	PURPOSE LIST	CFS	ACRE FEET	ACRE IRR	BUSINESS NAME	COUNTY NAME	WRIA	TRS	SOURCE NAME	DOCUMENT STATUS
4590078	CS3-*18476C(A)	Change/ROE	02/04/2009	IR	1	203	85.38	Alden Real Estate LLC	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4193171	CS3-*28452J	Change/ROE	06/10/2004	IF IR	4	690.9	190	Probert Family Trust	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4426252	CS3-*19006	Change/ROE	06/20/2006	IF	0		25	Billy Hindman Marital Trust	WALLA WALLA	32	T06N/R32E-02	WALLA WALLA RIVER	Active
2089213	CS3-*05605ALC	Change/ROE	04/24/1998	IR	2	400	100		WALLA WALLA	32	T07N/R34E-31	WALLA WALLA RIVER	Active
2089214	CS3-*11915C	Change/ROE	04/02/1997	IR	0	43.6	10.9		WALLA WALLA	32	T07N/R34E-31	WALLA WALLA RIVER	Active
4317022	CS3-*28780J@1	Change/ROE	08/01/2006	IF IR	1	102.44	30		WALLA WALLA	32	T07N/R36E-33	WALLA WALLA RIVER	Active
4145971	CS3-*28768JWRIS	Change/ROE	01/28/2003	IR	0	25	6	Howard J. Kelly Estate	WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
4193185	CS3-*28455J	Change/ROE	06/10/2004	IF IR	1	115.7	43	Probert Family Trust	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2144973	CS3-*04869C(B)	Change/ROE	09/10/2001	ST	0	8.4			WALLA WALLA	32	T07N/R32E-35	WALLA WALLA RIVER	Active
4589980	CS3-*28767J@1	Change/ROE	02/04/2009	IR	0	48.6	20.4	Alden Real Estate LLC	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4679893	CS3-*18476C(C)	Change/ROE	02/12/2009	IR	0	46	19.12		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4193161	CS3-*28877J(A)	Change/ROE	06/10/2004	IF IR	5	837.8		Probert Family Trust	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4687440	S3-*19006(10-17)	Temporary Use	05/10/1965	IF	1	325		Billy Hindman Marital Trust	WALLA WALLA	32	T06N/R32E-02	WALLA WALLA RIVER	Active
2145833	CS3-*28672J	Change/ROE	03/01/2001	IR	1	242.4	60		WALLA WALLA	32	T06N/R35E-13	WALLA WALLA RIVER	Active
2090008	CS3-*15244C	Change/ROE	07/23/1997	IR	1	120		Hassler Ranch	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4426263	CS3-*19007	Change/ROE	06/20/2007	IF	0		125	Billy Hindman Marital Trust	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2143485	CS3-*17599C	Change/ROE	11/21/1994	IR	2	652	163	US Army Corps Of Engineers	WALLA WALLA	32	T07N/R32E-20	WALLA WALLA RIVER	Active
4590039	CS3-*28871J(A)	Change/ROE	02/04/2009	IR	0	35.6	15	Alden Real Estate LLC	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2143435	S3-29174	Permit	04/02/1992	IR	5	500	680	Byerley Farms Profit Sharing Trust	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4316966	CS3-*10985C	Change/ROE	08/01/2006	IF IR	3	849.86	180		WALLA WALLA	32	T07N/R33E-36	WALLA WALLA RIVER	Active
4687625	S3-*19007(10-26)	Temporary Use	05/10/1965	IF	0	25		Billy Hindman Marital Trust	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2145800	CS3-*28864J	Change/ROE	01/18/2001	IR	0	37.8	10		WALLA WALLA	32	T06N/R35E-05	WALLA WALLA RIVER	Active
4680094	CS3-*28767J@1(B)	Change/ROE	02/12/2009	IR	0	10.9	4.6		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4250769	S3-CV2P602	Certificate of Change	01/01/1920	DS IR ST					WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2145506	S3-CV1P207	Certificate of Change	11/03/1941	IR	0	0			WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135848	S3-*13731C	Certificate	02/02/1956	IR	1	220	55		WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4251037	S3-CV1-3P135	Certificate of Change	01/01/1904	DS IR ST					WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4183928	S3-*18476C(A)	Certificate	04/30/1964	IR	0	492	123		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4427094	S3-*28877J(E)	Adjudicated Certificate		IR	0	50.05	10.01		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135112	S3-*20705CWRIS	Certificate	01/19/1968	IR	1	284	71	PIERCE L L & B J	WALLA WALLA	32	T07N/R32E-19	WALLA WALLA RIVER	Active
2135239	S3-*19385CWRIS	Certificate	12/15/1965	IR	1	248	62	DIRKS C A/D R	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134501	S3-*28415JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	2	380	76	OREGON&WA JNT STK LD	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134410	S3-*28632JWRIS	Adjudicated Certificate	01/01/1904	DS IR ST	2	375	75	BERGEVIN C	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134510	S3-*28424J	Adjudicated Certificate	01/01/1892	IR	1		34		WALLA WALLA	32	T06N/R35E-03	WALLA WALLA RIVER	Active
2132104	S3-21184CWRIS	Certificate	05/22/1973	IR	1	167	36	WA Fish & Wildlife Department	WALLA WALLA	32	T07N/R31E-26	WALLA WALLA RIVER	Active
2134512	S3-*28426JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	20	4	PORTLAND MTG	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135639	S3-*14584CWRIS	Certificate	11/19/1957	IR	2	368	92	BERGEVIN D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134033	S3-*28878JWRIS	Adjudicated Certificate	01/01/1901	DS IR ST	1	180	36	SINKLER S D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136884	S3-*01971CWRIS	Certificate	01/13/1927	IR	0		15	CORDINER W G	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2143904	S3-*28710J	Adjudicated Certificate	01/01/1908	IR	0	75	15		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2135414	S3-*18773C	Certificate	11/10/1964	IF	2	383		WA Ecology Department	WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
4427049	S3-*28877J(B)	Adjudicated Certificate		IR	0	60.75	12.15		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4251067	S3-CV1-3P249	Certificate of Change	01/01/1904	DS IR ST					WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2136575	S3-*07756C	Certificate	04/14/1947	IF	1	319		WA Ecology Department	WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
4211395	S3-CV1-3P139	Certificate of Change	01/01/1926	DS IR ST					WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134503	S3-*28417JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	75	15	SCHAEFER A	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134408	S3-*28630J	Adjudicated Certificate	01/01/1904	IR	2	450	90	Byerley Farms Profit Sharing Trust	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2145965	S3-22058C	Certificate	11/09/1973	IR WL	1	280	70	*WA Fish & Wildlife Department	WALLA WALLA	32	T07N/R32E-30	WALLA WALLA RIVER	Active
4174093	S3-*12701C(A)	Certificate	12/23/1953	IR	3	1212	303		WALLA WALLA	32	T06N/R33E-03	WALLA WALLA RIVER	Active
4250876	S3-CV2P908	Certificate of Change	01/01/1904	IR					WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2134635	S3-*28241JWRIS	Adjudicated Certificate	01/01/1884	DS IR ST	1	300	60	SMITH W C	WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2136107	S3-*11580CWRIS	Certificate	08/11/1952	IR	2		100	LOWDEN F M JR EST	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134537	S3-*28451JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	2	449.8	89.96	SINKLER S D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134508	S3-*28422J	Adjudicated Certificate	01/01/1892	IR	2		75		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134210	S3-*28740JWRIS	Adjudicated Certificate	01/01/1912	DS IR ST	0	75	15	MOJONNIER F E	WALLA WALLA	32	T06N/R35E-03	WALLA WALLA RIVER	Active
2135952	S3-*12495C	Certificate	08/07/1953	IR	3	960	240	Byerley Farms Inc	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2135650	S3-*14799CWRIS	Certificate	05/14/1958	IR	0	78	19.5	ESTES W C	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134514	S3-*28428JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	6.25	1.5	SHORT J M	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135569	S3-*16972C	Certificate	10/11/1961	IR	0	140	28		WALLA WALLA	32	T06N/R32E-02	WALLA WALLA RIVER	Active
2143321	S3-*19387C	Certificate	12/15/1965	IR	2	1200	300		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136152	S3-*11917C	Certificate	12/23/1952	IR	1		80		WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135299	S3-*19920C	Certificate	10/07/1966	IR	5	960	240	Byerley Farms Inc	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2145595	S3-CV1P179	Certificate of Change	01/01/1904	IR	0	0			WALLA WALLA	32	T07N/R32E-19	WALLA WALLA RIVER	Active
4250714	S3-CV1P254	Certificate of Change	11/03/1941	IR					WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4250748	S3-CV1-3P411	Certificate of Change	11/05/1941	IR					WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4183898	S3-*28871J(A)	Adjudicated Certificate	01/01/1926	IR	0	75	15		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134180	S3-CV1-3P475	Certificate of Change	01/01/1908	DS IR ST				STILLER FRANCIS	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2134299	S3-*28835J	Adjudicated Certificate	01/01/1926	DS IR ST	0	100	20		WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
2136720	S3-*04991C	Certificate	10/09/1939	IR	2	0	120		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136337	S3-*10985CWRIS	Certificate	01/21/1952	IR	4		180	LOWDEN F M JR/E B	WALLA WALLA	32	T07N/R33E-36	WALLA WALLA RIVER	Active

KEY_MAIN	DOCUMENT NUMBER	DOCUMENT TYPE	PRIORITY DATE	PURPOSE LIST	CFS	ACRE FEET	ACRE IRR	BUSINESS NAME	COUNTY NAME	WRIA	TRS	SOURCE NAME	DOCUMENT STATUS
2134246	S3-*28780JWRIS	Adjudicated Certificate	01/01/1918	DS IR ST	1	150	30	LOWDEN F M JR	WALLA WALLA	32	T07N/R34E-31	WALLA WALLA RIVER	Active
2136588	S3-*07930CWRIS	Certificate	07/18/1947	IR	1		99	PIERCE L L	WALLA WALLA	32	T07N/R32E-20	WALLA WALLA RIVER	Active
2134012	S3-*28855JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	1	135	27	JOHNSON K	WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2134014	S3-*28857JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	1	225	45	WELCH G T	WALLA WALLA	32	T07N/R37E-35	WALLA WALLA RIVER	Active
4427079	S3-*28877J(D)	Adjudicated Certificate		IR	0	50	10		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2145544	S3-CV1P158	Certificate of Change	01/01/1892	IR	0	0			WALLA WALLA	32	T07N/R34E-32	WALLA WALLA RIVER	Active
2134499	S3-*28413JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	75	15	PATTON M H	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135416	S3-*18785C	Certificate	11/23/1964	IR	2	480	120	Byerley Farms Inc	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2134029	S3-*28873JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	1	250	50	LOCKWOOD F M	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4250729	S3-CV1-3P412	Certificate of Change	12/23/1952	IR					WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134497	S3-*28411JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	1	200	40	MILLER D W	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135558	S3-*16788CWRIS	Certificate	07/17/1961	IR	1	200	40	DOW G F	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135376	S3-*18294CWRIS	Certificate	01/20/1964	IR	2	575	115	SOULE/BLACKABY	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134504	S3-*28418JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	60	12	SANDERS D W	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135326	S3-*20150CWRIS	Certificate	03/03/1967	IR	1	47	77	MUNNS A / H S	WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2136712	S3-*04869C	Certificate	06/10/1939	IR	3			ANDREW S C	WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
4250807	S3-CV1-3P195	Certificate of Change	01/01/1892	DS IR ST					WALLA WALLA	32	T07N/R34E-28	WALLA WALLA RIVER	Active
2145536	S3-CV2P758	Certificate of Change	01/01/1892	IR	1	0	75		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134789	S3-CV1-3P413	Certificate of Change	01/01/1870	IR	2		90		WALLA WALLA	32	T07N/R34E-30	WALLA WALLA RIVER	Active
2145286	S3-CV1P183	Certificate of Change	01/01/1904	IR	1	0			WALLA WALLA	32	T07N/R31E-26	WALLA WALLA RIVER	Active
2135443	S3-*19007	Certificate	05/10/1965	IR	1	150	30		WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
4182634	S3-*04869C(A)	Certificate	06/10/1939	IF	2	406.6		WA Ecology Department	WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
2134540	S3-*28454JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	1	175	35		WALLA WALLA	32	T07N/R34E-28	WALLA WALLA RIVER	Active
2136761	S3-*05605ALC	Certificate	11/05/1941	IR	2	0	100		WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4623509	S3-*28562J(C)	Adjudicated Certificate	01/01/1900	IR	1	143.56	37.78		WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
2134404	S3-*28626JWRIS	Adjudicated Certificate	01/01/1904	DS IR ST	0	100	20	UHLING CHAS S	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2134554	S3-*28468J	Adjudicated Certificate	01/01/1892	RE	0	60			WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
4184324	S3-*28562J(A)	Adjudicated Certificate	01/01/1900	IR	0	25.69	6.76	New Life Assembly of God Church	WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
2136797	S3-*06440C	Certificate	05/18/1945	IR	1	0	100		WALLA WALLA	32	T07N/R33E-35	WALLA WALLA RIVER	Active
4427020	S3-*28877J(A)	Adjudicated Certificate		IR	5	1208.1	241.62	Probert Family Trust	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135761	S3-*15760CWRIS	Certificate	11/04/1959	IR	3	320	80	WOODARD/WEBSTER ETAL	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136762	S3-*05607C	Certificate	11/07/1941	IR	1		50	COLLEY E L	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134539	S3-*28453JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	1	370	74	SINKLER S D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136697	S3-*04450CWRIS	Certificate	08/12/1937	IR	3		155	MONNICH/AULT	WALLA WALLA	32	T06N/R33E-04	WALLA WALLA RIVER	Active
2134407	S3-*28629J	Adjudicated Certificate	01/01/1904	IR	0	20	4		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4211381	S3-CV1-3P497	Certificate of Change	01/01/1916	DS IR ST					WALLA WALLA	32	T06N/R35E-05	WALLA WALLA RIVER	Active
2136075	S3-*13100C	Certificate	08/25/1954	IR	1	0	80		WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active
2145285	S3-CV1P182	Certificate of Change	01/01/1904	IR	0	0			WALLA WALLA	32	T07N/R32E-30	WALLA WALLA RIVER	Active
2134507	S3-*28421JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	1	250	50	KRUMBAH E	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136561	S3-*07549CWRIS	Certificate	11/25/1946	IR	2		250	Steen Flyways Inc	WALLA WALLA	32	T07N/R31E-25	WALLA WALLA RIVER	Active
2136643	S3-*08350CWRIS	Certificate	04/22/1948	IR	0		20	CUMMINGS C S G	WALLA WALLA	32	T07N/R32E-30	WALLA WALLA RIVER	Active
2134790	S3-CV1P253	Certificate of Change	01/01/1870	IR	0				WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134515	S3-*28429JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0		0.61	HAILSTON G	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134298	S3-*28834J	Adjudicated Certificate	01/01/1926	DS IR ST	1	150	30	BERGEVIN C O	WALLA WALLA	32	T07N/R35E-32	WALLA WALLA RIVER	Active
2135417	S3-*18787C	Certificate	11/23/1964	IR	0	80	20		WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2134396	S3-*28618JWRIS	Adjudicated Certificate	01/01/1903	DS IR ST	1	200	40	LEITZMAN C W	WALLA WALLA	32	T07N/R31E-25	WALLA WALLA RIVER	Active
2136185	S3-*12097C	Certificate	02/25/1953	IF	1	179		WA Ecology Department	WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
2136785	S3-*06208ALCWRIS	Certificate	10/19/1944	IR	0	175	35	DERUWE R	WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2136268	S3-*10288CWRIS	Certificate	05/02/1951	IR	0		40	FOWLER M T	WALLA WALLA	32	T06N/R33E-04	WALLA WALLA RIVER	Active
2136638	S3-*08288CWRIS	Certificate	03/19/1948	IR	1		45	CUMMINGS C S G	WALLA WALLA	32	T07N/R32E-30	WALLA WALLA RIVER	Active
2134030	S3-*28874JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	0	50	10	SCHNEBLY A R	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134281	S3-*28816JWRIS	Adjudicated Certificate	01/01/1924	DS IR ST	1	175	35	MILLER D W	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134783	S3-*28089JWRIS	Adjudicated Certificate	01/01/1870	DS IR ST	0	5	1	DENNIS A H	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135117	S3-*20723ALCWRIS	Certificate	01/29/1968	IR	2	522	174	LYNCH E J	WALLA WALLA	32	T07N/R32E-23	WALLA WALLA RIVER	Active
2135300	S3-*19921C	Certificate	10/07/1966	IR	1	256	64	Byerley Farms Inc	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
2134011	S3-*28854J	Adjudicated Certificate	01/01/1926	IR	0	125	25		WALLA WALLA	32	T06N/R35E-13	WALLA WALLA RIVER	Active
4172835	S3-*28786J	Adjudicated Certificate	01/01/1919	IR	0	25	5		WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2136319	S3-*10863C	Certificate	11/07/1951	IF	1	264.55		WA Ecology Department	WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active
2134498	S3-*28412JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	1	350	70	ACKLEY A C	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4242057	S3-CV1P350	Certificate of Change	07/28/1947	IR					WALLA WALLA	32	T06N/R33E-02	WALLA WALLA RIVER	Active
2145292	S3-CV3P1124	Certificate of Change	01/01/1904	IR	1	0	59.1		WALLA WALLA	32	T07N/R33E-36	WALLA WALLA RIVER	Active
2135568	S3-*16971C	Certificate	10/11/1961	IF	0	109		WA Ecology Department	WALLA WALLA	32	T06N/R32E-02	WALLA WALLA RIVER	Active
2145509	S3-CV1P481	Certificate of Change	10/09/1939	IR	0	0			WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4237158	S3-*28628J(B)	Adjudicated Certificate	01/01/1904	IR	0	25	5		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2129416	S3-*28628J(A)	Adjudicated Certificate	01/01/1904	IR	1	145	29		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2145577	S3-CV1P466	Certificate of Change	01/01/1895	IR	2	0			WALLA WALLA	32	T06N/R35E-11	WALLA WALLA RIVER	Active
2135132	S3-*20918CWRIS	Certificate	04/23/1968	IR	1	210	70	CONKEY V G	WALLA WALLA	32	T06N/R33E-02	WALLA WALLA RIVER	Active
4427063	S3-*28877J(C)	Adjudicated Certificate		IR	0	51.1	10.22		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134496	S3-*28410J	Adjudicated Certificate	01/01/1892	IR	3	705	141		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135081	S3-*20457C	Certificate	08/22/1967	IR	1	400	100		WALLA WALLA	32	T07N/R33E-35	WALLA WALLA RIVER	Active
2135902	S3-*14161CWRIS	Certificate	12/07/1956	IR	2	296	74	PIERCE LARRY ET UX	WALLA WALLA	32	T07N/R32E-20	WALLA WALLA RIVER	Active

KEY_MAIN	DOCUMENT NUMBER	DOCUMENT TYPE	PRIORITY DATE	PURPOSE LIST	CFS	ACRE FEET	ACRE IRR	BUSINESS NAME	COUNTY NAME	WRIA	TRS	SOURCE NAME	DOCUMENT STATUS
2145594	S3-CV1P178	Certificate of Change	01/01/1904	IR	1	0			WALLA WALLA	32	T07N/R32E-30	WALLA WALLA RIVER	Active
2134513	S3-*28427JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	45	9	ROHN A C	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2095307	S3-*28222J(B)	Adjudicated Certificate	01/01/1884	IR	0	36.8	7.36		WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2134013	S3-*28856JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	0	125	25	MILLER D W	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4242006	S3-CV1-3P86	Certificate of Change	10/07/1966	IR				Byerley Farms Inc	WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
4169776	S3-*28708J	Adjudicated Certificate	01/01/1908	IR	1	325	65		WALLA WALLA	32	T06N/R35E-05	WALLA WALLA RIVER	Active
2135528	S3-*16382CWRIS	Certificate	10/10/1960	IR	7	621.6	155.4	MCDOLE J R	WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active
2134026	S3-*28870J	Adjudicated Certificate	01/01/1926	IR	0	50	10		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2135462	S3-*19157CWRIS	Certificate	07/22/1965	IR	0	110	22	SOULE H B ET AL	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2143484	S3-*17599C	Certificate	10/30/1962	IR	2	652	163	US Army Corps Of Engineers	WALLA WALLA	32	T07N/R32E-20	WALLA WALLA RIVER	Active
2134794	S3-CV1-3P414	Certificate of Change	01/01/1870	IR					WALLA WALLA	32	T07N/R34E-31	WALLA WALLA RIVER	Active
2135762	S3-*15761C	Certificate	11/04/1959	IR	0	78	19.55		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136759	S3-*05603CWRIS	Certificate	10/31/1941	IR	0		32	BISHOP O	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135419	S3-*18805CWRIS	Certificate	12/08/1964	IR	1	280	70	MARTIN E W	WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2134017	S3-*28860J	Adjudicated Certificate	01/01/1926	IR	1	200	40		WALLA WALLA	32	T07N/R34E-31	WALLA WALLA RIVER	Active
2135991	S3-*12843CWRIS	Certificate	03/31/1954	IR	1		30	GARDNER F H	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134787	S3-*28093J	Adjudicated Certificate	01/01/1870	DS IR ST	2		90	LOWDEN M E	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134785	S3-*28091JWRIS	Adjudicated Certificate	01/01/1870	DS IR ST	0	10	2	Walla Walla School Dist 41	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135721	S3-*15244C	Certificate	01/20/1959	IR	1	120	30	Soule, Hardyn Et. Al.	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134015	S3-*28858JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	2	500	100	LOWDEN M E	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135387	S3-*18433CWRIS	Certificate	04/02/1964	IR	1	240	60	KLICKER MICHAEL D	WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
4251294	S3-CV1-3P206	Certificate of Change	01/01/1904	IR					WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
2134483	S3-*28397J	Adjudicated Certificate	01/01/1892	DS IR ST	0	100	20		WALLA WALLA	32	T06N/R35E-01	WALLA WALLA RIVER	Active
2135957	S3-*12546CWRIS	Certificate	09/01/1953	IR	1		155.4	MUNNS A/H S	WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2145524	S3-CV2P565	Certificate of Change	02/02/1956	IR	1	0			WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2145288	S3-CV2P612	Certificate of Change	01/01/1904	IR	6	0	300	Touchet Irrigation & Improvement Co	WALLA WALLA	32	T07N/R33E-25	WALLA WALLA RIVER	Active
2145283	S3-CV1P180	Certificate of Change	01/01/1904	IR	0	0			WALLA WALLA	32	T07N/R32E-19	WALLA WALLA RIVER	Active
2134492	S3-*28406J	Adjudicated Certificate	01/01/1892	DS IR ST	140	35000	7000	Walla Walla Irrigation Co	WALLA WALLA	32	T06N/R35E-03	WALLA WALLA RIVER	Active
2135389	S3-*18436C	Certificate	04/02/1964	IR	0	75	15		WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
2136166	S3-*12019CWRIS	Certificate	02/02/1953	IR	2		115	MARTIN E W/B J	WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2135764	S3-*15763CWRIS	Certificate	11/04/1959	IR	3	320	80	STOCKDALE H E	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136623	S3-*08179C	Certificate	01/12/1948	IF	2	415		WA Ecology Department	WALLA WALLA	32	T07N/R32E-26	WALLA WALLA RIVER	Active
4303970	S3-*08726C(A)	Certificate	03/14/1949	IR	4	702	175.5		WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active
2145290	S3-CV3P1048	Certificate of Change	01/01/1904	IR	1	0			WALLA WALLA	32	T07N/R33E-25	WALLA WALLA RIVER	Active
2134494	S3-*28408JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	65	13	DAULTON J W	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136364	S3-*11203C	Certificate	04/01/1952	IR	0	0	40		WALLA WALLA	32	T06N/R33E-04	WALLA WALLA RIVER	Active
2136381	S3-*11340CWRIS	Certificate	05/12/1952	IR	0		20	DEERINGHOFF W L	WALLA WALLA	32	T06N/R33E-03	WALLA WALLA RIVER	Active
2134509	S3-*28423JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	1	185	37	KRUMBAH E	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2145291	S3-CV3P1051	Certificate of Change	01/01/1904	IR	1	0			WALLA WALLA	32	T06N/R33E-02	WALLA WALLA RIVER	Active
2136592	S3-*07955CWRIS	Certificate	07/28/1947	IR	1		91	DUNNING R	WALLA WALLA	32	T06N/R33E-02	WALLA WALLA RIVER	Active
4251320	S3-CV1-3P208	Certificate of Change	11/28/1940	IR					WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
4251309	S3-CV1-3P207	Certificate of Change	01/01/1891	IR					WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
2143376	S3-*28104J(A)	Adjudicated Certificate	01/01/1872	IR	1	162.5	32.5		WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2134784	S3-*28090JWRIS	Adjudicated Certificate	01/01/1870	DS IR ST	0	35	7	LOOS E A	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2136106	S3-*11577CWRIS	Certificate	08/08/1952	IR	1		60	GARDNER L O ET AL	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134502	S3-*28416JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	3	800	160	LOWDEN F M JR	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2136124	S3-*11725CWRIS	Certificate	10/02/1952	IR	1		100	SMALL T B/E G	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4211408	S3-CV1P482	Certificate of Change	11/14/1929	DS IR ST					WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134016	S3-*28859JWRIS	Adjudicated Certificate	01/01/1926	DS IR ST	3	800	160	BUCKLEY T J	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135763	S3-*15762CWRIS	Certificate	11/04/1959	IR	0	26	6.45	AXTELL H E	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134634	S3-*28240JWRIS	Adjudicated Certificate	01/01/1884	IR	1	325	65		WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2135770	S3-*15841CWRIS	Certificate	01/06/1960	IR	2	362	90.5	BERGEVIN D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2132387	S3-01202CWRIS	Certificate	12/15/1965	IR	1	496	124	DIRKS CLARENCE ET UX	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135327	S3-*20151C	Certificate	03/03/1967	IR	1	71	43		WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2136467	S3-*09519CWRIS	Certificate	04/11/1950	IR	1		67	DODD D	WALLA WALLA	32	T07N/R33E-25	WALLA WALLA RIVER	Active
2134495	S3-*28409JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	3	650	130	REAVIS J L	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4174101	S3-*12701C(B)	Certificate	12/23/1953	IR	0	53.2	14	Hamada Land Co.	WALLA WALLA	32	T06N/R33E-03	WALLA WALLA RIVER	Active
2135610	S3-*17560C	Certificate	10/04/1962	IR	1	320	80		WALLA WALLA	32	T06N/R32E-01	WALLA WALLA RIVER	Active
4303986	S3-*08726C(B)	Certificate	03/14/1949	IF	0	6.8		WA Ecology Department	WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active
2143898	S3-*28631J	Adjudicated Certificate	01/01/1904	IR	0	125	25		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4250420	S3-CV1P363	Certificate of Change	01/01/1904	IR					WALLA WALLA	32	T07N/R32E-22	WALLA WALLA RIVER	Active
2134406	S3-*28628J	Adjudicated Certificate	01/01/1904	IR	1	225	45		WALLA WALLA	32	T07N/R35E-32	WALLA WALLA RIVER	Active
2145287	S3-CV1P184	Certificate of Change	01/01/1904	IR	1	0			WALLA WALLA	32	T07N/R32E-22	WALLA WALLA RIVER	Active
2134792	S3-CV1P251	Certificate of Change	01/01/1870	IR					WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134788	S3-CV1P252	Certificate of Change	01/01/1870	IR	0			DODD J J/M I	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134791	S3-*28094J	Adjudicated Certificate	01/01/1870	IR	1	250	50		WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134423	S3-*28645J	Adjudicated Certificate	01/01/1904	IR	6		300	Touchet Irrigation & Improvement Co	WALLA WALLA	32	T07N/R33E-25	WALLA WALLA RIVER	Active
2135559	S3-*16789CWRIS	Certificate	07/17/1961	IR	2	240	48	MORRIS A	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136610	S3-*08087CWRIS	Certificate	10/22/1947	IR	1		80	DERUWE R	WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active

KEY_MAIN	DOCUMENT NUMBER	DOCUMENT TYPE	PRIORITY DATE	PURPOSE LIST	CFS	ACRE FEET	ACRE IRR	BUSINESS NAME	COUNTY NAME	WRIA	TRS	SOURCE NAME	DOCUMENT STATUS
2136696	S3-*04449CWRIS	Certificate	08/12/1937	IR	1		55	MONNICH J W	WALLA WALLA	32	T06N/R33E-05	WALLA WALLA RIVER	Active
2135392	S3-*18475CWRIS	Certificate	04/30/1964	IR	2	312.5	62.5	STILLER F L	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2134424	S3-*28646J	Adjudicated Certificate	01/01/1904	IR	64		2400	Attalia Irrigation Dist 1	WALLA WALLA	32	T07N/R32E-22	WALLA WALLA RIVER	Active
4184339	S3-*28562J(B)	Adjudicated Certificate	01/01/1900	IR	0	77.75	20.46		WALLA WALLA	32	T07N/R35E-31	WALLA WALLA RIVER	Active
4252342	S3-CV1P4	Certificate of Change						Irrigation District No 2	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4250856	S3-CV1-3P138	Certificate of Change	01/01/1904	DS IR ST					WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136760	S3-*05604C	Certificate	11/03/1941	IR	1	0	50		WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134538	S3-*28452J	Adjudicated Certificate	01/01/1893	DS IR ST	4	950	190	SINKLER S D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135242	S3-*19398CWRIS	Certificate	12/18/1965	IR	3	720	180	WEAVER J W	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134506	S3-*28420JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	100	20	ENYART L	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134505	S3-*28419JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	0	90	18	FOUSTE J	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134541	S3-*28455J	Adjudicated Certificate	01/01/1893	DS IR ST	1	215	43	LOWDEN CO THE	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
4250887	S3-CV2P988	Certificate of Change	01/01/1904	IR					WALLA WALLA	32	T07N/R35E-32	WALLA WALLA RIVER	Active
2136110	S3-*11596CWRIS	Certificate	08/19/1952	IR	1		67	TAYLOR R/J	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2135910	S3-*14203CWRIS	Certificate	01/24/1957	IR	2	760	190	MARTIN E W ET UX	WALLA WALLA	32	T06N/R33E-06	WALLA WALLA RIVER	Active
2145284	S3-CV1P181	Certificate of Change	01/01/1904	IR	0	0			WALLA WALLA	32	T07N/R32E-19	WALLA WALLA RIVER	Active
2135442	S3-*19006	Certificate	05/10/1965	IR	1	350	70	Byerley Farms Inc	WALLA WALLA	32	T06N/R32E-02	WALLA WALLA RIVER	Active
4211348	S3-CV2P580	Certificate of Change	01/01/1891	DS IR ST					WALLA WALLA	32	T06N/R34E-04	WALLA WALLA RIVER	Active
4250688	S3-CV3P1043	Certificate of Change	01/01/1904	IR					WALLA WALLA	32	T07N/R33E-35	WALLA WALLA RIVER	Active
2134405	S3-*28627JWRIS	Adjudicated Certificate	01/01/1904	DS IR ST	0	35	7		WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
4211365	S3-CV2P757	Certificate of Change	01/01/1892	DS IR ST	1				WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134511	S3-*28425J	Adjudicated Certificate	01/01/1892	DS IR ST	1	200	40		WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2136701	S3-*04511CWRIS	Certificate	03/25/1938	IR	1		50	LOCKWOOD S	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2145289	S3-CV2P930	Certificate of Change	01/01/1904	IR	2	0			WALLA WALLA	32	T06N/R33E-02	WALLA WALLA RIVER	Active
2135797	S3-*13279ALCWRIS	Certificate	02/02/1955	IR	2	422	105.5	NELSON O A	WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
4183920	S3-*18476C(B)	Certificate	04/30/1964	IR	0	40	10	Walla Walla River Packing & Storage	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134500	S3-*28414JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	3	750	150	RADER C M	WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
4212103	S3-CV2P526	Certificate of Change	01/01/1892	DS IR ST			20		WALLA WALLA	32	T06N/R35E-11	WALLA WALLA RIVER	Active
2134161	S3-*28687JWRIS	Adjudicated Certificate	01/01/1907	DS IR ST	1	250	50	CORDINER W G	WALLA WALLA	32	T06N/R35E-03	WALLA WALLA RIVER	Active
4183909	S3-*28871J(B)	Adjudicated Certificate	01/01/1926	IR	0	50	10	Walla Walla River Packing & Storage	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134493	S3-*28407JWRIS	Adjudicated Certificate	01/01/1892	DS IR ST	2	550	110	BERGEVIN J D	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2143503	S3-*28833J	Adjudicated Certificate	01/01/1926	IR	1	150	30	Byerley Farms Profit Sharing Trust	WALLA WALLA	32	T07N/R34E-36	WALLA WALLA RIVER	Active
2134793	S3-CV1P196	Certificate of Change	01/01/1870	IR					WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2145507	S3-CV1P381	Certificate of Change	11/03/1941	IR	0	0			WALLA WALLA	32	T07N/R34E-33	WALLA WALLA RIVER	Active
2134450	S3-*28672J	Adjudicated Certificate	01/01/1906	DS IR ST	2		96		WALLA WALLA	32	T06N/R35E-12	WALLA WALLA RIVER	Active
2136676	S3-*08786CWRIS	Certificate	05/10/1949	IR	1		47.2	WORKMAN W P	WALLA WALLA	32	T06N/R33E-04	WALLA WALLA RIVER	Active
2136733	S3-*05113CWRIS	Certificate	03/25/1940	DM IR ST	0		10	FEHMER M	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2135547	S3-*16596C	Certificate	03/24/1961	IR	6	1104	276		WALLA WALLA	32	T07N/R32E-36	WALLA WALLA RIVER	Active
2132053	S3-20913CWRIS	Certificate	03/14/1973	IR	0	116.2	25	MICKELSON LAVERN	WALLA WALLA	32	T07N/R31E-25	WALLA WALLA RIVER	Active
2134250	S3-*28784J	Adjudicated Certificate	01/01/1919	IR	0	20	4		WALLA WALLA	32	T06N/R35E-04	WALLA WALLA RIVER	Active
2134268	S3-*28803ABBJWRIS	Adjudicated Certificate	01/01/1920	DS IR ST	1	250	50	LOWDEN E B	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active
2134018	S3-*28862J	Adjudicated Certificate	01/01/1926	DS IR ST	1	150	30	KING F	WALLA WALLA	32	T07N/R34E-35	WALLA WALLA RIVER	Active